Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

A56.9
R31
Cop.3

U. S. DEPT
NATIONAL
MAR 18 [illegible]
CURRENT [illegible]

ABSTRACTS

of recent published material on Soil and Water Conservation

Number 24

ARS 41-71
Agricultural Research Service

UNITED STATES DEPARTMENT OF AGRICULTURE

"ABSTRACTS of recent published material on Soil and Water Conservation" are abstracted by Charles B. Crook, Soil and Water Conservation Research Division of the Agricultural Research Service.

They are issued at irregular intervals. Their purpose is to bring together a summary of current published information about soil and water conservation for ready reference of those actively engaged in soil and water conservation work. Reprints of abstracted articles are generally not available in the Division. Requests for reprints should be sent to authors or institutions--addresses enclosed in parentheses have been appended to the title of each abstract.

This is a special issue of selected papers presented at the 7th International Congress of Soil Science, held at Madison, Wis., in 1960.

Author summaries, conclusions, or aims are given verbatim as written in the four volumes of the proceedings. The regular classification scheme of "ABSTRACTS" is used throughout. In most cases, particularly the ones from foreign countries, papers were abstracted that were deemed complete enough to bring out the information of the paper without going to the original article. For the above reason, many good papers were not used--including a whole section on soil maps of various countries and some descriptions of soil types, both in Volume IV.

This is the twenty-fourth of the publications issued under this title. The following previous issues are not available for distribution: (1) USDA-SCS (Processed), March 1949; (2) USDA-SCS (Processed), Sept. 1949; (3) USDA-SCS (Processed), July 1950; (4) USDA PA-143, Nov. 1950; (5) USDA PA-173, June 1951; (6) USDA PA-192, Dec. 1951; (7) USDA PA-213, Oct. 1952; (8) USDA PA-228, July 1953; (9) USDA ARS 41-1, Dec. 1954; (10) USDA ARS-41-3, Aug. 1955; (11) USDA ARS-41-5, Dec. 1955; (12) USDA ARS-41-8, July 1956; (13) USDA ARS-41-17, July 1957; (14) USDA ARS-41-22, July 1958; And (15) USDA ARS-41-30, Feb. 1959.

The following are available for distribution:

(16)	USDA	ARS-41-35	Aug.	1959
(17)	USDA	ARS-41-38	July	1960
(18)	USDA	ARS-41-39	Oct.	1960
(19)	USDA	ARS-41-45	Feb.	1961
(20)	USDA	ARS-41-46	May	1961
(21)	USDA	ARS-41-50	Aug.	1961
(22)	USDA	ARS-41-58	May	1962
(23)	USDA	ARS-41-67	Jan.	1963

Soil Conservation Service personnel should address requests for additional copies of ABSTRACTS to the appropriate State Conservationist.

Authors of articles and reports in the field of soil and water conservation are urged to supply abstracts, reprints, or copies to R. S. Dyal, Soil and Water Conservation Research Division, Agricultural Research Service, U.S. Department of Agriculture, Plant Industry Station, Beltsville, Maryland.

CONTENTS

Page

WATER MANAGEMENT
- Irrigation........ 1
- Drainage........ 3

BASIC SOIL SCIENCE
- Soil physics........ 5
- Soil chemistry........ 22
- Soil biology........ 44
- Soil - plant - animal relationships........ 54
- Soil classification........ 56

EROSION CONTROL
- Erosion equation........ 68
- Wind and water erosion........ 68

SOIL MANAGEMENT
- Cropping practices........ 69
- Crop residue management........ 69
- Tillage........ 70
- Fertility requirements for conservation farming........ 72
- Salinity and alkali problems........ 79
- Climatic influences........ 84
- Mulching........ 85

PLANT MANAGEMENT
- Woodlands........ 85

SUPPLEMENT
- Radioactive fallout........ 86

WATER MANAGEMENT

Irrigation

Jensen, M. E., and Musick, J. T. THE EFFECTS OF IRRIGATION TREATMENTS ON EVAPOTRANSPIRATION AND PRODUCTION OF SORGHUM AND WHEAT IN THE SOUTHERN GREAT PLAINS. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 386-393. 1960. (SWCRD, ARS, USDA, Fort Collins, Colo.)

Experiments with irrigation treatments on grain sorghum and winter wheat were conducted at Bushland, Texas, (latitude 35°15′ N) and Garden City, Kansas, (latitude 37°59′ N) from 1956 to 1959. Seasonal evapotranspiration (ET) for maximum yields was 22—24 inches for sorghum and 22—29 inches for wheat. Cumulative ET curves were similar between locations except for a lag of about 5 inches by wheat in Kansas caused by lower winter and spring temperatures and delayed growth relative to Texas. Maximum rates for 10- to 15-day periods were 0.30 to 0.35 inch per day and occurred from late boot through early heading stages of growth.

Sorghum yields increased more rapidly with increasing ET than wheat and had a much higher yield potential. The quantity and distribution of rainfall greatly affected sorghum yields when ET was less than 19 inches. Stage of plant growth and maturity had a major effect on ET independent of air temperatures. Therefore, empirical methods for estimating ET should adjust for stage of growth.

Mech, S. J. SOIL MANAGEMENT AS RELATED TO IRRIGATION PRACTICES AND IRRIGATION DESIGN. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 645-650. 1960. (SWCRD, ARS, USDA, Prosser, Wash.)

Two-parameter intake rate equations, $i = at^b$, have been computed for crops in a 7-year rotation of wheat-alfalfa, alfalfa, alfalfa, alfalfa, potatoes, sugar beets, and corn. The influence of crop, age of alfalfa, furrow grade, soil moisture and stream size on the parameters 'a' and 'b' have been determined.

The parameter 'a' was consistently low for row crops and increased progressively when the land was seeded to alfalfa and remained in alfalfa. It remained relatively uniform throughout the growing season.

The parameter 'b' was relatively uniform throughout the season only for established alfalfa. For row crops it ranged from about —0.40 at the beginning of the season to about —0.10 by the first part of September when it approximated that found for alfalfa.

Cumulative irrigation curves have been developed for more accurate and less laborious determination of irrigation duration.

Doss, B. D., Bennett, O. L., Ashley, D. A., and Ensminger, L. E. INTERRELATIONS OF NITROGEN FERTILIZATION AND IRRIGATION OF THREE FORAGE GRASSES. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 496-503. 1960. (SWCRD, ARS, USDA, Thorsby, Ala.)

Yield response of Coastal bermudagrass, Bahiagrass and Dallisgrass to six rates of nitrogen fertilization (0, 75, 150, 300, 450, 600, and 900 pounds per acre) with and without irrigation was determined in field experiments carried out at Thorsby, Alabama, from 1956 to 1959.

The response to irrigation differed from year to year depending on the amount of rainfall received during the growing season. The greatest response to irrigation occurred in 1956 which was the driest of the four years.

There was a highly significant yield response to rates of nitrogen by all three species for all years with the greatest response from Coastal bermudagrass and the least from Dallisgrass.

The yields of these grasses were increased by either additional nitrogen fertilizer or by irrigation. However, a far greater influence was obtained when both were used together. When the grasses were well fertilized and irrigated, the efficiency of both nitrogen and water use was increased. Failure to supply an adequate amount of either nitrogen or water can offset the gains possible from the other.

Bennett, O. L., Scarsbrook, C. E., Doss, B. D., and Pearson, R. W. INTERRELATION OF NITROGEN FERTILIZATION AND IRRIGATION OF COTTON. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 657-662. 1960. (SWCRD, ARS, USDA, Thorsby, Ala.)

Studies were conducted at Thorsby, Alabama, on a Red Bay sandy loam soil over a 3-year period to determine the effects of three moisture levels and 5 levels of nitrogen on yields, growth characteristics, and fiber quality of cotton. Yield, boll rot, boll weights, height of plants, nitrogen content of plants, stample length, fiber strength, micronaire values and lint percentage were measured.

Shubin, V. R. WINTER IRRIGATION TO CONTROL DROUGHT AND SOIL OVERHEATING. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 616-621. 1960. (Agr. Inst., Stalingrad, U.S.S.R.)

Winter irrigation in semidesert areas of supercontinental climate is of hydrothermical importance.

According to the experiments on the light-chestnut soils of the Volga-Don Canal regions winter watering gives a decrease of temperature of 3—4° C in the course of vegetative period and 4—6° C in spring (we give these figures in comparison with those of non-winterirrigated fields).

Winter-fall irrigation is of great importance not only for hydrothermical regime of the soil but for the soil itself.

It breaks down clods of compact soil, makes it flocculated improving soil structure, makes water penetration easier and decreases the concentration of salts.

It helps in controlling noxicus insects and destroys rodents.

Winter irrigation results in the stimulating of plant growth and the increase of yields.

For the arid South Volga regions the soil temperature of 28—30° C (at a depth of 15—20 cm) is normal. And this is in the period that tubers begin to form. High temperature stops the growing of tubers.

But on winter watered fields the soil temperature does not exceed 26° C and there is no degeneration of tubers the products of photosynthesis being removed normally.

Winter irrigation is rather simple, it requires less technical equipment, while it is more effective and cheaper than any form of irrigation during the period of vegetation.

It costs 4 times less than the watering during the vegetative period and 5 times less than artificial raining.

The use of this irrigation results in a high efficiency of the irrigation system, its effectiveness being extended over a longer period.

Szabolcs, I. DEGRADATION OF IRRIGATED SOILS IN HUNGARY. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 638-644. 1960. (Res. Inst. Soil Sci. and Agr. Chem. of the Hungarian Acad. Sci., Budapest, Hungary.)

1. In the irrigated areas of the Hungarian Lowland soil-degradation is very wide-spread and exerts an unfavourable influence on the fertility of the soil.
2. Both the data of the 5 % KOH-extract of the soil and the examination of exchangeable bases present evidence of the particular degradation in connection with alkalization, the SiO_2/Al_2O_3 ratio of the soils in question is very wide, the exchange complex shows signs of definite degradation (decreasing S, increasing T—S).
3. In irrigated soils the surface layer always shows the process of degradation contrary to soils degraded under dry conditions in which case the A_2-layer often shows a maximum.
4. In consequence of degradation the physical, chemical and biological characteristics of the soil deteriorate with regard to its fertility.
5. Organic fertilization and the planting of leguminous plants decrease degradation. Probably similar effects can be reached with improving the soil.

Drainage

Thiel, T. J., and Taylor, G. S. UTILIZING A SAND TANK MODEL TO STUDY SOME MOISTURE FLOW PROBLEMS IN DRAINAGE. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 473-479. 1960. (SWCRD, ARS, USDA, Columbus, Ohio.)

A small tank model is described for studying subsurface drainage problems. Provisions are made for varying drain depth and spacing. Glycerine-sand flow systems are used, and fluid pressures are measured at 42 locations during drawdown. By using capillary manometer tubing, reliable measurements of fluid pressure are obtained without using null-type tensiometers. Experiments are conducted in a constant-temperature room and at low humidity to avoid significant changes in fluid viscosity. An example of the type of problem which can be studied is illustrated by some experimental findings for drawdown in homogeneous media.

Kirkham, D. AN UPPER LIMIT FOR THE HEIGHT OF THE WATER TABLE IN DRAINAGE DESIGN FORMULAS. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 486-492. (Iowa State U., Ames, Iowa.)

A formula is derived for an upper limit of water table rise above a system of drains which remove rain water or excess irrigation water at a steady rate. The formula is the same as one derived by the author in a cited previous paper, except that the height, as earlier given, must be multiplied by a factor $1/(1—R/k)$, where R is the rainfall rate and k is the soil hydraulic conductivity, both in the same units. The earlier formula which is an approximation is, by use of the factor, established on a firmer basis.

Ede, A. N. SCHEME FOR THE ASSESSMENT AND DESIGN OF FIELD DRAINAGE SYSTEMS ON A HYDROLOGY BASIS. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 493-506. 1960. (Ministry Agr., Fisheries and Food, London, England.)

The difficulties in applying rigid design methods to water-table control are connected with assumptions which have to be made as to the steady state, and to the ineffectiveness of permeability measuring methods. To obviate these a method is being tested of arriving indirectly at figures for the water conducted through inadequately drained fields under known water-table conditions, and the changes in water storage accompanying fluctuations in water-table height. In the subsequent drainage design the depth of drains allows a definite 'buffer' zone in the soil to accommodate the likely peak storms.

Taylor, G. S., Worstell, R. V., and Luthin, J. N. PONDED WATER FLOW IN LAYERED SOILS. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 480-485. 1960. (J. N. Luthin, U. Calif., Davis, Calif.)

An analog study of ponded flow into drains was conducted in layered soils. When the drains are located in a layer whose conductivity is low compared to the other two layers, a high percentage of the potential is dissipated very close to the drain.

Without exception, the stream lines intersect the ground surface at smaller horziontal distances from the drain center line in the layered soils than in the homogeneous soils. This displacement of the stream lines indicates that a greater percentage of the total flow enters the medium at a small horizontal distance from the drain.

For a particular conductivity profile, an increase in drain depth causes a stream line to intersect the ground surface at greater horizontal distances from the drain.

When the conductivity ratio of two adjacent layers is less than five, then placement of the drain in the less permeable lower layer does not significantly reduce the drain flow. If the ratio exceeds five, drain flow is greatly reduced when the drain is placed in the less permeable layer.

Edminster, T. W. CONTROL OF SURFACE WATER BY LAND FORMING. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 411-417. 1960. (SWCRD, ARS, USDA, Beltsville, Maryland.)

Land forming rearranges the earth's surface permitting improved water management. Through *adjustment* of the micro-relief of a field, positive surface drainage can be *achieved*. By grading to selected slopes, uniform irrigation may be applied with a minimum of ponding or erosion. Smooth uniform fields facilitate high speed mechanization of farming operations.

Land forming, *made possible* by the rapid advancement in heavy earth-moving equipment, can tailor a field for optimum water management. While the basic designs and techniques of this practice are widely recognized, there still remain many critical problems that challenge the soil scientist and engineer alike.

At present the grades recommended for land forming are based on standard grades for irrigation practice. If a design engineer had more precise knowledge of the rates of infiltration that could be expected on a formed field plus definite values for the rate of advance of furrow or border streams, he might well modify the leveling design. By modifying grades, slope lengths, adjusting tolerances in row grade, or the degree of cross-slope, distinct savings might be made in the volume of earth moved.

More specific knowledge of plant-nutrient and soil-structure problems that are likely to develop following radical earth moving must be obtained. Just exactly what happens to the surface infiltration rates under cut, fill, and neutral conditions? What influence do the various techniques of spreading and compacting fill have upon the rate of water transmission through the redeveloped profile? How do variations in soil type or in previous soil management practices influence crop response and water movement following a land forming program? What adjustment should be made in earth moving techniques and in the subsequent tillage and crop management practices to overcome the structural damage that may have occurred? These are but a few of the questions that research must answer before land forming can become fully utilized as a water management practice.

BASIC SOIL SCIENCE

Soil Physics

Puri, B. R., and Mahojan, O. P. THE USE OF CHARCOAL AS A SOIL CONDITIONER. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 598-606. 1960. (Punjab U., Chandigarh, India.)

Charcoal of a high cation exchange capacity can be prepared at a very low cost from readily available sources by suitable treatments. It can be made to have H^+, Na^+, K^+, NH_4^+ or Ca^{++} or any other common cation at its surface to the extent of 800—1000 m.e./100 g. The treatment of sodium soil with H-Charcoal lowers its alkalinity considerably. The treatment with Ca-Charcoal results in the transference of appreciable amounts of Ca^{++}-ions to the soil complex in exchange for its Na^+. Similarly, the treatment of H-soil with K-, and Ca-Charcoals raises its pH value and results in the transference of K^+ and Ca^{++}-ions to the soil in exchange for its H^+. The transference of ions can take place even when no water is added and the materials are in air-dried or oven-dried states. The amount of the reaction, however, is larger in the presence of water. The amount of Charcoal required to be added for the amendment of alkali or acid soils is quite small. The use of H-Charcoal or Ca-Charcoal in the improvement of alkali soils is indicated. Its advantages over the use of gypsum or an acid or an acid salt have been pointed out. H-Charcoal can neutralise free alkali due to the presence of Na_2CO_3 in soil moisture as well. The possibilities of using NH_4-Charcoal as a manure and Ca-Charcoal for increasing the calcium status of irrigation waters have been discussed.

Boodt, M. De. SPECIAL REPORT ON SOIL STRUCTURE MEASUREMENTS. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 290-299. 1960. (State Agr. U., Ghent, Belgium.)

Surveying the actual methods of soil structure measurements, we find that the structure evaluation on one and the same soil gives different results in the various laboratories. Standardisation of the basic soil structure measurements is proposed, including sampling, transportation and storage of the samples for aggregate stability and pore-size distribution determination as well as the standardisation of those two methods themselves.

Besides this, field methods to give a quick and efficient answer on specific questions in respect to soil structure improvements are more than ever necessary. Based on an extensive bibliography study together with our own experience, practical suggestions are made as to how the standardisation could be tried out and as to which method could be used in the field.

Dabin, B. UTILISATION D'UN INDICE DE STRUCTURE POUR LA DÉTERMINATION DE LA QUALITÉ PHYSIQUE DES SOLS TROPICAUX. [UTILIZATION OF A STRUCTURE INDEX FOR THE DETERMINATION OF THE PHYSICAL NATURE OF TROPICAL SOILS.] Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 311-320. 1960. (Dir. Res., Abidjan, Côte d'Ivorie, Africa.)

We have tried to establish indices of structure that will enable us to assess the relative structural quality of soils by grouping the different measurable values of stability, porosity and moisture characteristics. These indices aim primarily to effect a pedological classification of soils rather than to be used as tools in plant-physiological studies.

We have three main indices:

Index of structure: $F_1 = S \times \sqrt{Pu \times Eu}$

Index of drainage: $F_2 = A \times \text{Log } 10 \text{ K}$

Edaphic humidity: $He = \dfrac{\sqrt{Pu \times Eu}}{S}$

where

Pu = useful porosity
Eu = available water
A = air capacity = Pd = drainage porosity
S = structural stability
K = permeability.

Lemon, E., and Kristensen, J. AN EDAPHIC EXPRESSION OF SOIL STRUCTURE. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 232-240. 1960. (SWCRD, ARS, USDA, Ithaca, N.Y.)

The soil as a three phase system is quantitatively defined as a geometric term in a steady state radial flow equation applicable to plant roots. The soil structure parameter is expressed as units of length and is evidently the apparent liquid path length. The method of measurement relies upon oxygen flux to a simulated plant root (oxygen cathode) within the high moisture range (greater than 30 % soil moisture by volume), and possibly hydroxyl ion flux away from the simulated root surface for moisture contents less than 30 %. Fortuitously, the limitation of the soil environment on the simulated root behavior parallels that of real roots. The apparent liquid path length is assumed to thus represent the resistance component of the soil environment in the radial flow equation. A testing of the hypothesis against a few plant growth data add support to this belief.

van Bavel, C. H. M. SOIL DENSITY MEASUREMENT WITH GAMMA RADIATION. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 284-289. 1960. (SWCRD, ARS, USDA, Tempe, Ariz.)

The physical principles of soil densitometry by gamma transmission are discussed. It is shown how they can be applied to instrumental design problems such as gamma source selection, strength of source, distance to detector, anticipated precision and time of measurement. The disturbing effect of hydrogen in the soil is explained and analyzed.

Hillel, D. CRUST FORMATION IN LOESSIAL SOILS. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 330-339. 1960. (Agr. Res. Sta., Rehovot, Israel.)

The study attempts to define certain crusting processes which result from the physical slaking of the surface soil in the course of wetting-drying cycles.

Dried slaking crusts are characterized mainly by bulk density and mechanical strength.

The change in porosity (densification) resulting from defined wetting-drying cycles is related to the degree of wetting. The tendency to densification and crusting increases as the degree of wetting approaches saturation. It appears that the major structural changes involved in the process of crusting result from the saturation of the surface layer during infiltration. The zone of crusting is thus identical with the zone of saturation in the infiltration process.

The original porosity profile of a soil column determines the moisture distribution during wetting, and consequently the structural changes found after drying.

The actual densification occurs primarily in the course of the shrinking which accompanies the drying process. Crust strength increases with greater uniformity and slower rates of drying. Crust strength is inversely related to moisture content.

Soil puddling is employed in an effort to determine the maximal degree of crusting possible for any given soil material allowed to dry freely from a saturated state, and the relation of spontaneous crusting effects to this maximal degree.

Hanks, R. J. SOIL CRUSTING AND SEEDLING EMERGENCE. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 340-346. 1960. (SWCRD, ARS, USDA, Manhattan, Kans.)

When considering seedling emergence in relation to crust strength, it is evident that moisture content is a very important factor. Seedling emergence will be limited when the soil dries because (a) the crust strength increases, and (b) the ability of the seedling to emerge at constant crust strength decreases. Practical methods to eliminate crust strength as a factor limiting seedling emergence should minimize soil drying. A stable mulch would appear suitable.

Soil crusting was shown to be related to bulk density by a relationship of the form, crust strength = KA^d, where d is bulk density and K and A are constants. The moisture content at the time of crust formation was directly related to crust strength if broken dry, but the moisture content at the time the crust was broken was inversely related to crust strength. The moisture content at the start of a rain was inversely related to air dry crust strength.

Greacen, E. L. AGGREGATE STRENGTH AND SOIL CONSISTENCE. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 256-264. 1960. (Commonwealth Sci. and Indus. Res. Organ., Adelaide, South Australia.)

The unique relation between the equilibrium water content and the consolidation load in a saturated clay, which is continually strained by a shear force, describes the condition when interparticle bonds, frictional or ortherwise, are not contributing to the compressive strength of the clay.
On the assumption that a suction in the soil water acts as a mechanical load in a saturated clay, the equivalent strength of a clay aggregate is defined as that suction on the suction—water content line for the straining clay which corresponds to the water content of the aggregate. It is shown how a crude value of the equivalent strength can be obtained with the Atterberg limits. This agrees reasonably well with the field description of the consistency of five different clays.

Franzeson, V. A. WATER STABLE STRUCTURE OF CHERNOZEM IN RELATION TO ITS FERTILITY. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 404-410. 1960. (All-Union Inst. Fert. and Agronomical Soil Sci., Moscow, U.S.S.R.)

The following statements have been discussed in the present paper:
1. A more complete specification of the water stable structure of the soil requires simultaneous determination both of water stable aggregates, which remain intact when air dry soil is thrown into water, and of conditionally water stable aggregates, which retain water stability only upon preliminary capillary moistening.

2. In considering the lower limit of valuable water stable aggregates in the soil due account should be taken of the size of the water retaining pores at a moisture equal to the field water holding capacity. For loamy and clay chernozems with deep ground waters the lower limit of valuable structure are aggregates of 0.01 mm in diameter.

3. Physicomechanical processes, such as drying up and prolonged moistening, mechanical pressure, etc, may give rise in chernozems to a certain number of water stable aggregates and to a very great number of conditionally water stable aggregates.

4. The effect of soil aggregates upon the properties of the plough layer depends not only on the character of aggregates themselves, but also upon their distribution in respect to one another, i.e. on the fabric of the plough layer.

Lutz, J. F., Gracia-Lagos, R., and Hilton, H. G. THE EFFECT OF PHOSPHATE FERTILIZERS ON SOME PHYSICAL PROPERTIES OF SOIL. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 241-248. 1960. (N. C. Agr. Expt. Sta., Raleigh, N.C.)

On the basis of the data presented, it is obvious that heavy applications of phosphate produced significant and highly significant differences in certain physical-chemical properties of these red podsolic soils in the Piedmont Plateau Region of North Carolina. Since laboratory-treated samples gave differences as great as those found in the field and, since there was no macro-biological growth in the laboratory samples, it is concluded that the differences are due to physical-chemical changes rather than to biological activity. The significant differences in moisture content, in bulk density, and in other physical properties verify and explain the differences observed in the field.

Adams, E. P., Blake, G. R., Martin, W. P., and Boelter, D. H. INFLUENCES OF SOIL COMPACTION ON CROP GROWTH AND DEVELOPMENT. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 607-615. 1960. (SWCRD, ARS, USDA, St. Paul, Minn.)

Field plots were deliberately packed prior to planting sugar beets, potatoes, corn and wheat. Treatments included: (1) surface packing, (2) packing in plow bottom (subsurface) (3) subsurface plus surface packing and (4) no packing.

Potato yields were lowered 54 %, sugar beets 13 %, wheat 13 %, and corn 7.5 % by surface packing. Subsurface plus surface packing reduced corn yields from 84.5 to 72.2 bu./A., a 14.5 % reduction.

Packing increased surface soil bulk density from 1.07 to 1.19 gr.cc^{-1}, reduced air space at 60 cm. water tension from approximately 15 % to 9 % (at 20—27 cm. depth to 5.3 %), reduced air permeability and penetrability.

Packing doubled percent sprangled beets, did not significantly affect sugar percentage. Potato tubers were 2.2 cm. nearer the soil surface, had significantly lower specific gravities, but neither numbers nor scab or silver scurf infection were affected by packing. Corn population was decreased, but thinning removed this variable from yields. Corn germination was slowed with consequent delayed maturity.

The following conclusions are made:

1. Severe packing profoundly affects crops in some years though there may be a threshhold value of compaction not ordinarily exceeded by most conventional tillage methods in most years.
2. Continued and accumulative packing can have many effects on crops other than yield differences, for example specific gravity of potato tubers.
3. The data show that relationships between soil properties and crop yield must take into account deeper soil horizons than simply the plow layer.
4. Low percentage of pores drained at 60 cm suction on packed soils indicate that inadequate diffusion of gases during some parts of the growing season are perhaps a major cause of the crop effects noted.

Leenheer, L. De., and Ruymbeke, M. Van. IS IT POSSIBLE TO PREDICT SOME PHYSICAL SOIL CHARACTERISTICS, KNOWING THE SOIL COMPONENTS? Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 272-278. 1960. (State Agr. U., Ghent, Belgium.)

This paper reports equations, one set for meadow and one set for arable land, for predicting values of soil physical properties of undisturbed soil from properties measured in the laboratory on disturbed samples from the corresponding soils. The physical properties considered are apparent density, field moisture capacity, wilting point, drainable pore space porosity, water retention porosity, and aggregate stability. The laboratory values are percent clay (0—2 micron), percent silt (2—20 micron), percent coarse silt (0—50 micron), percent $CaCO_3$, percent organic matter, pH in water, exchange capacity, percent water at sampling. The physical properties which could best be predicted were apparent (bulk) density and wilting point. The calculations were performed on an IBM-650 electronic computer.

Gliński, J., and Dobrzánski, B. CHANGES IN THE STRUCTURE AND PROPERTIES OF MOUNTAIN SOILS UNDER THE INFLUENCE OF TERRACING. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 577-583. 1960. (Dept. Soil Sci., Agr. Col., Lubin, Poland.)

Terracing of slopes situated in mountainous regions produces changes in the morphological make-up and properties of mountain soils.

These changes concern mainly the thickness of the profile and especially of the humus layer and the humus content in the soil.

The soils of terraced slopes are characterized by a considerable depth which is often more than 2m, and by a comparatively small skeleton content.

The humus horizon reaches a considerable thickness (up to 130 cm).

The total amount of humus in the terraced slopes is about 700 metric tons per ha greater than in the non-terraced slopes.

The humus content of the terraced slopes is considerable: about 5 per cent in the depth 5—15 cm and about 1 per cent 1 m below the surface.

The soils of terraced slopes are less acid than those of non-terraced slopes.

Owing to a decrease of the inclination of slopes by about a half and to an increase of the thickness of the soil profile, terracing has a positive influence on the retention of water.

De Roo, H. C. ROOT DEVELOPMENT IN COARSE TEXTURED SOILS AS RELATED TO TILLAGE PRACTICES AND SOIL COMPACTION. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 622-628. 1960. (Conn. Agr. Expt. Sta., New Haven, Conn.)

In hand-tilled plots on moderately coarse textured soil, we found that deep rooting of tobacco was primarily effected by breaking the resistance to root penetration created by a compaction pan at plow depth. Neither the penetration nor distribution of the roots was greatly influenced by fertility.

The yield of roots was increased by both deep tillage and fertilizer with concomitant increases in the yield of leaf and the concentration of nitrate and nicotine in the leaf.

Subsequently, in plots tilled by machinery, consistent increases in yield followed spring-time deep plowing plus subsoiling and deep fertilization from the furrow bottom or followed spring-time sub-base plowing with half of the fertilizer plowed down. When fluffed up, these soils are readily recompacted and the benefits nullified.

Fehrenbacher, J. B., Johnson, P. R., Odell, R. T., and Johnson, P. E. ROOT PENETRATION AND DEVELOPMENT OF SOME FARM CROPS AS RELATED TO SOIL PHYSICAL AND CHEMICAL PROPERTIES. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 243-252. 1960. (U. Ill., Urbana, Ill.)

Root studies of corn, soybeans, alfalfa, red clover, and timothy on Brunizem, Gray-Brown Podzolic, and Planosol soils in Illinois showed that proper soil fertilization increased root penetration and development and crop yields. Increasing the soil rooting volume of crops increases the supply of water and nutrients available to plants.

Corn roots penetrated deeply in fertilized Brunizems (Flanagan and Muscatine), and in Gray-Brown Podzolic (Wartrace) soils which had thick, permeable solums, favorable structure, and medium bulk densities. Corn roots did not penetrate the fine textured *C* horizon which occurred at shallow depth, lacked soil structure, and had a high bulk density in Brunizems such as Clarence, even when fertilized.

Shallow rooting of crops on Planosols (Cisne, Huey, and Weir) was due largely to low fertility. With proper fertilization, roots of all crops studied, except timothy, penetrated and were well developed in the 'claypan' *B* horizon.

Fox, R. L., and Lipps, R. C. DISTRIBUTION AND ACTIVITY OF ROOTS IN RELATION TO SOIL PROPERTIES. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 260-267. 1960. (Nebr. Agr. Expt. Sta., Lincoln, Nebr.)

The importance of deeply penetrating roots has been demonstrated by studies of plant root distribution, moisture extraction and nutrient utilization. Methods were described for estimating root activity using radioactive and stable isotopes. Subirrigated alfalfa roots below a depth of 7 feet were shown to contribute more than 60 % of the total root activity during the autumn when the surface soil was dry and subsoil temperatures relatively high.

Hidding, A. P., and Berg, C. van den. THE RELATION BETWEEN PORE VOLUME AND THE FORMATION OF ROOT SYSTEMS IN SOILS WITH SANDY LAYERS. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 369-373. 1960. (Inst. Land and Water Mangt. Res., Wageningen, the Netherlands.)

The cause for the absence of root systems in sandy layers with a low silt- and humus content, will often be the mechanical obstruction to the penetration and secondary growth of roots. From the examined natural profiles and from artificially built profiles, it appeared that rooting is prevented by means of mechanical resistance when the pore volume is less than 40 % of the total soil volume.

Wood, R. A. THE RELATIONSHIP BETWEEN SOIL MOISTURE UTILIZATION AND ROOTING DEPTH IN THE TROPICS. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 364-368. 1960. (Agr. Res. Sta., Lilongwe Nyasaland, Africa.)

To assist efficient land use planning one of the basic requirements is a knowledge of the relative water use of crops of economic importance. With Nyasaland's climatic pattern of clearly defined wet and dry seasons common to large areas of the tropics it has been possible to study this by following changes in soil moisture storage and utilization under different crops and rotations. Moisture used by maize, tobacco and groundnuts has been compared with that removed by various types of fallow, and variations in water use noted can be directly related to the density and type of root system developed. This relationship has also emphasized the need for conserving available water under plantation crops, particularly tea, where beneficial effects on yield due to improved cultural practices, have been brought about as a result of a detailed study of the mature plant's water use and moisture requirements during the protracted dry season.

Richards, L. A. ADVANCES IN SOIL PHYSICS. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 67-79. 1960. (SWCRD, ARS, USDA, Riverside, Calif.)

The object of this paper is to give a review of some of the general aspects of the physics of soil water. This subject provides ample complication to attract and to occupy the full attention of specialists, but it also touches or borders, more or less intimately, most of the other branches of soil science, and it is hoped that some aspect of this talk will be of use and interest to each of you.

Gurr, C. G., and Marshall, T. J. UNSATURATED PERMEABILITY--ITS MEASUREMENT AND ITS ESTIMATION FROM OTHER PROPERTIES OF THE MATERIAL. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 306-310. 1960. (Commonwealth Sci. and Indus. Res. Organ., Adelaide, South Australia.)

A method is described of measuring in a soil column the water content profile, the rate of water movement and the suction gradient for both steady and non-steady state water movements caused by evaporation at the surface of the column. Water contents are measured by the absorption of a narrow gamma ray beam passing through the column, and soil water suction by tensiometers.

From the data obtained, the permeability of the soil to water as a function of water content or suction is obtained, and the relation between soil water content and suction established from which permeability values may be calculated and compared with the measured permeability values.

Richards, L. A., and Ogata, G. VAPOR PRESSURE DEPRESSION AT A TENSIOMETER CUP. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 279-283. 1960. (SWCRD, ARS, USDA, Riverside, Calif.)

A thermocouple psychrometer previously described by the authors was used for determining the physical status of water at the air-water interface of a porous cup such as that used in soil moisture tensiometers. The usual gas-liquid phase arrangement for a tensiometer was reversed since the psychrometer was exposed to the air inside the porous cup when the outside of the cup was immersed in water or salt solution at controlled pressure less than atmospheric pressure. The relative pressure, p/p_0, of the water vapor in the air inside the porous cup could thus be controlled either by the pressure reduction across the porous wall (matric suction) or by the osmotic pressure of the solution in the porous wall, or both. The experimental results conform to theory which requires that a unit of matric suction is equivalent to a unit of osmotic pressure in reducing relative vapor pressure.

Mortier, P., Boodt, M. De., Dansercoer, W., and Leenheer, L. De. THE RESOLUTION OF THE NEUTRON SCATTERING METHOD FOR SOIL MOISTURE DETERMINATION. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 321-329. 1960. (M. De Boodt, State Agr. Col., Ghent, Belgium.)

The resolution of a source-detector assembly to measure soil moisture by neutron scattering depends on the dimensions of the detector, on the location of the source with respect to the detector and on the moisture content of the soil. It is shown experimentally that by the use of an auxiliary moderator of suitable dimensions the resolution can be substantially improved.

Bouwer, H. A STUDY OF FINAL INFILTRATION RATES FROM CYLINDER INFILTROMETERS AND IRRIGATION FURROWS WITH AN ELECTRICAL RESISTANCE NETWORK. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 448-456. 1960. (SWCRD, ARS, USDA, Tempe, Ariz.)

In the design of a furrow irrigation system, optimum degrees of adequacy, uniformity, and efficiency of irrigation are obtained by proper selection of the length and slope of the furrow, the stream discharge in relation to the infiltration characteristics of the soil, and the desired application. Some of these factors are dictated by the dimensions and topography of the field for reasons of economy. This would leave the stream discharge as the only variable at the designer's disposal. The analyses in this study show, however, that the furrow shape, through its effect on *W*, is another variable that may provide an additional tool for achieving optimum irrigation performance.

Bertrand, A. R., and Parr, J. F. DEVELOPMENT OF A PORTABLE SPRINKLING INFILTROMETER. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 433-440. 1960. (SWCRD, ARS, USDA, Watkinsville, Ga.)

A portable sprinkling infiltrometer has been developed which consists of a single spray nozzle mounted on a telescoping aluminum tower, a plot frame, a runoff collecting device, an automatic runoff recorder, and a transportable water supply system.

Simulated rainfall is provided by a nozzle which sprays downward on a plot of 1/3000 acre. Nozzle spray characteristics evaluated include drop size, drop distribution and terminal velocity. Procedures, methods and results are presented. Intensities of water application are 2.5, 3.25, and 4.6 inches per hour with water drops ranging in size from 0.5 mm to 4.5 mm in diameter. Terminal drop velocities range from 14.5 to 17.5 ft/sec.

Infiltration is measured by determining the difference between water application and runoff. Automatic recording of runoff is obtained by use of a portable water stage recorder.

Preliminary results indicate that this equipment is satisfactory for determining infiltration rates of Agricultural Soils.

Olsen, T. C., and Swartzendruber, D. MODEL STUDY OF THE DOUBLE-RING INFILTROMETER IN LAYERED SYSTEMS. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 441-447. 1960. (SWCRD, ARS, USDA, Lafayette, Ind.)

Infiltration of water was studied experimentally in a wedgeshaped sand model built as a sectorial portion of the double-ring infiltrometer flow system. Measurements of infiltration velocity for localized portions of the flooded sand surface permitted the assessment of buffer effects.

Results were obtained both for sand containing a thin horizontal layer of silt, and for the same sand containing an impermeable horizontal layer. In the case of the silt, the one-dimensional flow velocity, or infiltration rate, was obtainable by buffering only in the system of outer ring radius, r_n, of 24 inches; for $r_n = 12$ inches or less, the infiltration velocity exceeded the infiltration rate regardless of buffering. For the impermeable layer, the infiltration velocity in the system $r_n = 24$ inches could be reduced 80 per cent by buffering; this compared with a theoretical 100 per cent reduction expected after the wet front reached the impermeable layer. All results suggest the utility of using large ring systems of $r_n = 24$ inches, and this agrees with conclusions previously made for uniform (non-layered) flow systems.

Taylor, S. A., and Cary, J.W. ANALYSIS OF THE SIMULTANEOUS FLOW OF WATER AND HEAT OR ELECTRICITY WITH THE THERMODYNAMICS OF IRREVERSIBLE PROCESSES. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 80-90. 1960. (Utah State U., Logan, Utah.)

Saturated soil samples of Millville silt loam were packed into lucite cylinders to bulk densities of approximately 1.5 g cm^{-3}. Thermal, electrical, or salt concentration gradients were then applied individually across the soil. Each of these gradients created a hydraulic pressure difference across the sample. This was due to water flow induced by the fluxes of heat, electricity, and salts. In the thermal system there developed up to 0.111 millibars of hydraulic water pressure per degree of temperature difference across the 10 cm. sample. The electrical potential system developed up to 3.6 millibars per volt across the sample. A concentration gradient of NaCl was found to cause up to 98 millibars per mho of electrical conductivity difference across the sample. Thermodynamics of irreversible processes and Onsager's reciprocal rate equations were applied to the analysis of the experimental data from the systems. This analysis shows that the steady state pressure difference is a result of the ratio of the linked mobility coefficient for water to move in response to fluxes of heat, electricity and salt to the hydraulic mobility coefficient for water through the soil.

Brown, D. A., Place, G. A., and Pettiet, J. V. THE EFFECT OF SOIL MOISTURE UPON CATION EXCHANGE IN SOILS AND NUTRIENT UPTAKE BY PLANTS. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 443-449. 1960. (U. Ark., Ark. Agr. Expt. Sta., Fayetteville, Ark.)

Increasing the soil moisture from the wilting percentage to saturation resulted in significant increases in the uptake of N, P, K and Ca by cotton and soybean plants. The relationship in most cases, was linear over the available moisture range. Moisture levels between the 1/3 and 0 atmosphere tension resulted in a reduction in the uptake of these ions in some instances. The P uptake-moisture relationship for two and six-weeks-old soybeans were similar, the main difference being in the amount of P absorbed.

Increases in the uptake of Ca and K by plants and resin membranes were similar over the available moisture range. At moisture values beyond this the exchange properties of the resin membrane resulted in a preferential absorption of Ca over K the reverse being true for the soybean plants, more K than Ca being absorbed. Transpirational loss of water and the absorption of Ca, K, and P increased simultaneously over the available moisture range, however, beyond this, transpirational losses continued to increase while the uptake of Ca, K and P decreased.

Tschapek, M. CONCERNING THE FORCES OF WATER RETENTION BY SOILS. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 138-146. 1960. (Instituto de Suelos Y Agrotecnia, Cerviño 3101, Buenos Aires, Argentina.)

1. Investigations on the influence of surface tension (σ) upon retention of water by soil show, that up to P.W.P. capillary force has an outstanding importance.

2. Investigations on the influence of capillary and osmotic forces upon water movement in the soil, at reduced moisture content, permit to establish that capillary forces are predominant while osmotic forces have no influence whatsoever.

3. For thermodynamic analysis it is suggested to include as a variable a free surface energy of water, which would permit the use of a capillary pressure without any connection with a 'macro' pressure (P).

Vuorinen, J. ON SOIL MOISTURE TENSION IN LOAMY FINE SAND AND LOAMY SILT. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 91-96. 1960. (Agr. Res. Cent., Dept. Soil Sci., Helsinki, Finland.)

Glacial till or moraine is the largest group of soil types in Finland. It is mainly covered with forest. On agricultural land the mineral fresh water sediments of glacial origin are in the majority. As a result of sedimentation these contain typical, very well sorted soil types. Thus we can show typical regions of very heavy clay soils, of fine silt soils, of coarse silt and finesand soils, and small areas of sand soils and gravel eskers.

Silt and finesand soils are loose in texture and close to each other grain size, silt containing over 50 pct. of particles of 0.002—0.02 m.m. and finesand for the greater part particles of 0.02—0.2 m.m. Especially between the finer finesand (mainly 0.02—0.06 m.m.) and silt there is a marked difference in their use for agriculture. Silt is a very readily settling, water-tight, hard and quickly drying soil, whereas finesand is always moist or well attended with water for plants.

This paper presents some of the laboratory experiments made in an investigation of the quality of these two Finnish soils. Special attention is given to the soil moisture tension in the series of soils (sand—finesand—silt—clay) under similar conditions. It seems that the water in finesand and in silt is very well fixed and that especially in finesand the soil moisture tension increases very slowly.

Franzmeier, D. P., Whiteside, E. P., and Erickson, A. E. RELATIONSHIP OF TEXTURE CLASSES OF FINE EARTH TO READILY AVAILABLE WATER. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 354-363. 1960. (Mich. Agr. Expt. Sta., East Lansing, Mich.)

A) The readily available water capacity (RAWC) of a soil is a better estimate of the water available for plant growth than are the usual measures of available water.
B) The amount of water held in a soil against 6 atmospheres tension is a function of the clay content of the soil.
C) Of the textural classifications examined, the USDA classes are most closely correlated with RAWC values. However, Marshall's rectangular coordinate diagram gives good correlations and offers some advantages.
D) The U.S. engineers' separation between sand and silt at 0.074 mm. is apparently nearer to a more useful separation between these fractions than either the 0.2, 0.06 or 0.02 mm. separation of the International Soil Science Society or the 0.05 mm. limit used by the USDA. Sand and silt were separated at 0.10 mm. in the diagrams presented in Figure 1.
E) Trends in the lines separating textural classes in the diagrams used in Australia and the Netherlands more closely parallel differences in

RAWC than do those in the other diagrams mentioned.

F) More useful and simpler textural classifications could be developed with the information currently available.

G) It is proposed that such a classification be attempted by the International Soil Science Society. The cooperation of other professional groups, particularly geologists and engineers should be solicited in this task.

Flocker, W. J., and Nielsen, D. R. RELATIONSHIP BETWEEN SOIL MOISTURE AND AIR SPACE ASSOCIATED WITH LEVELS OF BULK DENSITY THAT INFLUENCE GROWTH OF TOMATOES. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 347-353. 1960. (U. Calif., Davis, Calif.)

Relationships between soil suction, moisture content, soil aeration, and levels of bulk density were investigated. Tomato plants were grown in two soils at various levels of bulk density. Soil suction, soil moisture and air space were controlled to a narrow range of desired levels. It is concluded that soil suction, mechanical impedance, or a combination of both influenced the growth of tomato plants.

Youngs, E. G. THE HYSTERESIS EFFECT IN SOIL MOISTURE STUDIES. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 107-113. 1960. (Agr. Res. Council Unit Soil Physics, Huntingdon Road, Cambridge, England.)

The hysteresis in the relationship between the suction and moisture content of a porous material complicates the computation of moisture profile developments when both wetting and draining are occurring at the same time in the same porous body. Two examples of such profiles are discussed: first, the profiles obtained during the redistribution of moisture after the cessation of infiltration with the surface maintained at saturation; and secondly, the profiles obtained during the infiltration at a constant rate which is less than that required to maintain the surface saturated. In the latter experiments, after an initial period of time, a constant moisture content region is formed behind a moisture front moving downwards with a constant velocity, making possible a measurement of the unsaturated hydraulic conductivity with an easy means of determining the moisture content.

Taylor, S. A., and Slatyer, R. O. WATER-SOIL-PLANT RELATIONS TERMINOLOGY. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 394-403. 1960. (Utah State U., Logan, Utah.)

The rapid development of knowledge and understanding of water-soil-plant relations has resulted in an urgent need for a more precise, yet potentially more comprehensive system of terminology connected with the system. The choice of thermodynamic terminology to meet this need has several distinct advantages (1) Water relations of soils and plants are governed by thermodynamic variables; (2) Movement of water through soils and plants at constant temperature has been attributed to thermodynamic forces, and even though these forces may not cause the flow, it seems that the appropriate kinetic processes and equations can be expressed in thermodynamic language; (3) Thermodynamic properties are readily observable and measurable; (4) The relations are basic and sufficiently flexible to allow for considerable development of the science by expanding the terminology; (5) It provides a set of terms that are equally applicable to both plant and soil water relations.

Hagan, R. M., and Vaadia, Y. ANALYSIS OF WATER-SOIL-PLANT RELATIONSHIPS. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 374-385. 1960. (U. Calif., Davis, Calif.)

Inadequate attention to soil-plant-environment as a whole, lack of sufficiently comprehensive hypotheses relating soil moisture and plant growth, and limitations of present expressions for soil moisture availability all contribute to conflicting reports in the literature.

Plant growth does not depend directly on soil moisture supply but rather on the balance between transpired and absorbed water which is dependent on soil, plant and climatic factors. Plant water balance cannot be predicted from soil moisture data only nor from transpiration data alone.

Determinations of soil moisture availability — either soil moisture content or suction — cannot be expected, on theoretical grounds, to be uniquely related to plant growth. Expressions relating soil moisture content and/or suction to plant growth will be empirical and applicable to the crop only under prevailing soil, climatic and management conditions. Such relationships cannot provide *basic irrigation principles* of wide application but can support irrigation recommendations useful in given situations.

Holmes, J. W., Greacen, E. L., and Gurr, C. G. THE EVAPORATION OF WATER FROM BARE SOILS WITH DIFFERENT TILTHS. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 188-194. 1960. (Commonwealth Sci. and Indus. Res. Organ., Adelaide, South Australia.)

The soil moisture profile established by steady state evaporation from the surface of a bare-fallowed soil, was measured directly. The computation of the profile by an extension of the Darcy equation and measurements of unsaturated permeability, agreed reasonably well with observation.

By observations in a wind tunnel, the rate of approach of the soil to a steady profile by drying and establishing a mulch zone at the surface, was shown to be strongly influenced by surface tilth. A fine tilth, containing soil crumbs predominantly of 2.5 mm diameter size, was more effective in slowing the rate of water loss than either the untilled condition or coarse clods at the surface.

Tanner, C. B. A SIMPLE AERO-HEAT BUDGET METHOD FOR DETERMINING DAILY EVAPOTRANSPIRATION. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 203-209. 1960. (U. Wis., Madison, Wis.)

The evapotranspiration from crop surfaces can be determined from a combination of the simplest aerodynamic and heat budget measurements. The method requires a measurement for an hour during the day of wind at one level and the temperature and vapor pressure gradients within one meter of the surface together with the net radiation, and soil heat flux. These measurements for one hour are used to 'calibrate' the simple aerodynamic system. From this calibration and the average wind and temperature gradients over periods of net radiation gains and losses respectively, the sensible heat for the period is estimated. The evapotranspiration over either the daytime and nighttime period is found from the aerodynamic estimate of the sensible heat, the measured net radiation, and the measured soil heat flux for the respective period.

The method is most suitable when the evapotranspiration (latent heat flux) is larger than the sensible heat flux.

Mederski, H. J., and Stackhouse, J. RELATION OF PLANT GROWTH AND ION ACCUMULATION TO SOIL MOISTURE LEVEL STABILIZED WITH A DIVIDED ROOT TECHNIQUE. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 467-474. 1960. (Ohio Agr. Expt. Sta., Wooster, Ohio.)

A split root technique was devised in which a portion of a corn plant's root system developed in soil at several known moisture contents while the remainder of the root system developed in a sand culture. The sand culture supplied most of the transpired water, minimized soil moisture change during growth, and prevented moisture stress within the plant irrespective of soil moisture level.

The data show that per cent K and total K increased as soil moisture increased in the range of wilting point to field capacity. This increased K uptake with increasing soil moisture level is attributed to a more rapid renewal of K in solution at the root surface. At low soil moisture contents the K absorbed by the plant may originate in the immediate vicinity of the root surface. At high soil moisture levels the absorbed K may originate at greater distances from the root and may be transported to the root in response to water absorption by the plant.

Hutcheon, W. L., and Rennie, D. A. THE RELATIONSHIP OF SOIL MOISTURE STRESS AND NUTRIENT AVAILABILITY TO THE GROWTH CHARACTERISTICS AND QUALITY OF WHEAT. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 488-495. 1960. (U. Saskatchewan, Saskatoon, Saskatchewan, Canada.)

Hard red spring wheat was grown in the growth chamber under a range of conditions of soil moisture, and with varying levels of supply of nitrogen and phosphorus.

Under these conditions, and regardless of the quantity of available nutrients, the total crop yield and the nitrogen and phosphorus content of the grain were most strongly influenced by water stress and associated characteristics of available moisture. The variations in quality of the grain were much more pronounced when nitrogen supplies were low, but significant variations still occurred when yields were not limited by a lack of either nitrogen or phosphorus.

A single period of stress at any stage of crop growth, even though followed by favourable moisture conditions for the remainder of the growing period, also produced a marked effect on yield and composition of the grain.

The total phosphorus, and the soil and fertilizer phosphorus content of the grain varied depending on the moisture conditions. It may be concluded that even a moderate stress, never in excess of two atmospheres, may have a detrimental effect on the plant, and the plant root system. It is also suggested that the movement of soil phosphorus to the plant root may be affected by the physical condition of soil moisture.

These experiments were conducted in relatively small volumes of soil and the variability of the data in relation to moisture conditions indicates the need for close study of techniques relative to the proper interpretation of experiments conducted in greenhouses and growth chambers. Very little attention is paid to the comparative regulation of the lower limits of soil moisture conditions under these circumstances.

Moldenhauer, W. C., Burrows, W. C., and Swartzendruber, D. INFLUENCE OF RAINSTORM CHARACTERISTICS ON INFILTRATION MEASUREMENTS. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 426-432. 1960. (SWCRD, ARS, USDA, Ames, Iowa.)

Infiltration velocities are estimated for runoff plots by use of the φ-index which is calculated from the rainfall histogram and the total amount of runoff. Eighty-eight storms covering a ten-year period are used in the study.

The φ-index is then considered successively as a function of time, t; of t and antecedent precipitation index, P; and finally of t, P and rainfall intensity, I. P accounts for very little variation in φ, but φ decreases with t in the manner characteristic of infiltration velocities. It is also found that φ increases with I, even beyond the point at which runoff begins.

Gardner, W. R. MEASUREMENT OF CAPILLARY CONDUCTIVITY AND DIFFUSIVITY WITH A TENSIOMETER. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 300-305. 1960. (SWCRD, ARS, USDA, Riverside, Calif.)

Three methods for the measurement of capillary conductivity and soil-water diffusivity with a tensiometer are described. In the first method water is removed from the soil through the tensiometer cup at a constant rate and the time dependence of the suction in the cup is measured. In the second method, water is removed at a constant suction and the time dependence of the flux is measured. In the third method a limited quantity of water is withdrawn at time $t = 0$ and the rate of return of the tensiometer manometer to equilibrium is recorded. The water content change of the soil is kept small so that solutions of the flow equation for constant conductivity can be used to calculate the conductivity. The diffusivity is calculated from the conductivity and the specific water capacity of the soil. Preliminary results agree well with those obtained by other methods.

Haise, H. R., Viets, F. G., and Robins, J. S. EFFICIENCY OF WATER USE RELATED TO NUTRIENT SUPPLY. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 663-671. 1960. (SWCRD, ARS, USDA, Fort Collins, Colo.)

Data are presented to show water use efficiency as influenced by nitrogen fertilizer appliciaton for various grass and grain crops grown at different locations and under limited and adequate moisture conditions. Other plant nutrients were adequate in most cases. Where available soil moisture is adequate and plant response is obtained with added nitrogen, water use efficiency and dry matter production are markedly increased. Usually, the greatest increase in water use efficiency occurs between zero and the first increment of added nitrogen.

Regression coefficients for the relationship between yield and water use efficiency varied from crop to crop and season to season. Linearity of the relationship was due to the essentially constant water use regardless of fertilizer rate or amount of dry matter produced. Under limited moisture conditions, similar increases in water use efficiency with nitrogen fertilizer use are observed but with lower dry matter production. Increasing water use efficiency does not necessarily mean more profitable production.

Hence, it is important to consider economic aspects as well as most efficient use of water.

Erickson, A. R., and VanDoren, D. M. THE RELATION OF PLANT GROWTH AND YIELD TO SOIL OXYGEN AVAILABILITY. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 428-434. 1960. (Mich. State U., East Lansing, Mich.)

Studies in the greenhouse and in the field have demonstrated that the platinum microelectrode method can be used to determine when soils are oxygen deficient for optimum plant growth and yield.

Oxygen deficiency for a one day period can have a great influence on growth and yield of plants. The magnitude of this affect will depend on the species and variety of the plant and its stage of development as well as light, temperature, fertility, etc.

Cultivated soils are usually only oxygen deficient for short periods of time. The importance of the length of time that the soil is deficient is discussed. The measurement of oxygen diffusion rate recovery after a uniform storm is demonstrated as a means of measurement of plant-soil-oxygen relations.

Wijk, W. R. van., and Gardner, W. R. SOIL TEMPERATURE AND THE DISTRIBUTION OF HEAT BETWEEN SOIL AND AIR. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 195-202. 1960. (Agr. U., Wageningen, the Netherlands.)

In studies of soil temperature the heat flux entering the soil per unit of surface has hardly ever been considered. Yet it is an important quantity in determining soil temperature.

It is strongly affected by mulching, irrigation, tillage and similar operations and depends on the type of the soil as well as on weather conditions. A method to determine this quantity for short periods of sunshine during a cloudy day is described. The results confirm the theoretical expectation that relatively more heat is transferred to the soil the shorter the period of its exposure to sunshine.

Bloodworth, M. E. EFFECT OF SOIL TEMPERATURE ON WATER USE BY PLANTS. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 153-163. 1960. (Tex. Agr. Expt. Sta., Agr. and Mech. Col. Tex., College Station, Tex.)

Plant scientists agree that growth is the result of a complex chain of closely interrelated processes, many of which are directly influenced by temperature. Studies concerning the relationship of soil and air temperatures to water absorption and the effectiveness of a thermal method for measuring the water movement rate under such conditions were conducted under controlled environment conditions in the laboratory with cotton plants. Soil temperatures were controlled ± 1° F. by a newly-designed combination circulating water and electrical heating system, and the aerial parts of the plants were subjected to variable conditions of climate by a recently developed controlled environment system.

Data obtained from the use of fruiting cotton plants indicate that the thermoelectric method provided an immediate, simple technique for studying the relationship between soil temperatures and the environment which prevailed around the aerial parts of the plants. The results also indicate that the absorption of water by the plants under study was curtailed greatly below about 60° F., even with a pronounced reduction in air temperature and an ample supply of available soil moisture.

The rate of water absorption increased with an elevation of soil and air temperatures; however, soil temperature greater than 107° F. usually caused a depression in water flow rates, probably because of injury to some of the absorbing areas of the more tender roots. Vigorous cotton plants were sometimes killed when soil temperatures remained at 50° F. for 20 to 24 hours. Aerial temperatures during the same period ranged between 75° and 79° F.

The reported preliminary studies concerning relative humidity indicate that this climatic variable does play an important role in affecting water use by cotton plants. This fact appears to be more pronounced at the lower temperature of 70° F. than at the elevated temperature of 100° F.

Results of the study are useful in helping to clarify several aspects concerning the effect of soil and air temperatures on transpiration by certain agricultural plants and have direct application to field problems of this nature, especially in regions where wide diurnal fluctuations between soil and air temperatures occur.

Lingle, J. C. GROWTH AND PHOSPHORUS UPTAKE BY TOMATO SEEDLINGS AS INFLUENCED BY SOIL TEMPERATURE, APPLICATION RATE AND WATER SOLUBILITY OF APPLIED PHOSPHORUS. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 618-624. 1960. (U. Calif., Davis, Calif.)

Differentially fertilized tomato plants were grown in Yolo fine sandy loam soil pots in constant-temperature water baths at 12°, 18°, 24° and 36° C. Differential fertilization consisted of P^{32}-tagged fertilizers of varying phosphate water solubility of 10, 45, or 90 percent of the available P_2O_5 applied at rates of 0, 100, and 200 pounds P_2O_5 per acre.

Growth was increased significantly with each increase in soil temperature. Positive responses to phosphate were observed with both rates of phosphate application and all water solubilities except the 10 percent water-soluble form at the low rate of application.

Phosphorus concentration in the tissue also increased with soil temperatures and rates of phosphate application. Increasing the water solubility of the applied phosphate increased phosphorus concentration except that high and median solubility gave similar results at the high rate of application.

The percentage of phosphorus in the plant that was derived from the fertilizer decreased with increasing soil temperature, and with the age of the plant. It increased with higher rates of application and the water solubility of the applied phosphate.

Total phosphorus uptake reflected the effect of treatment on growth and phosphorus concentration in the tissue.

Miller, R. D., Baker, J. H., and Kolaian, J. H. PARTICLE SIZE, OVERBURDEN PRESSURE, PORE WATER PRESSURE AND FREEZING TEMPERATURE OF ICE LENSES IN SOIL. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 122-129. 1960. (Cornel U., Ithaca, N.Y.)

Relationships between particle size, overburden pressure, pore water pressure and freezing temperature of ice lenses in soil are derived for systems of uniform spheres in regular states of packing. The derivations involve geometric approximations, the assumption of osmotic pressure in the film between an ice lens and soil particles which support it and a pressure discontinuity at a curved ice-water interface given by the classical surface tension equation. Experimental data obtained with narrow fractions of fine silt conform to values calculated for uniform spheres.

Richards, S. J., Weeks, L. V., and Warneke, J. E. COMPACTED BULK DENSITY AND HYDRAULIC CONDUCTIVITY FOR INDICATING THE STRUCTURAL STATUS OF SOILS. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 248-255. 1960. (U. Calif., Riverside, Calif.)

A method is given for measuring compacted bulk density for soil samples taken as fragmented samples from fields or plots. This index and the subsequent evaluation of the hydraulic conductivity on the compacted samples are suggested means of evaluating the structural status of soils.

Using the method described, compacted bulk density was measured as a function of the soil water content. For each soil a value of water content was found which resulted in a minimum bulk density. This water content at minimum compaction appeared to be related to an equivalent water film thickness 0.3 to 0.6 $\times$ 10^{-6} cm. based on specific surface measurements.

Hydraulic conductivity of soil samples compacted at 1/3- to 2/3-bar water retention values are proving helpful in evaluating the use of soil amendments.

Soil Chemistry

Nijensohn, L. A METHOD FOR THE DETERMINATION OF CATION EXCHANGE VALUES IN SALINE-CALCAREOUS-GYPSEOUS SOILS. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 36-44. 1960. (Inst. de Suelos y Riego-Faculated de Cicencias Agrarias, Mendoza, Argentina.)

A method is described with various alternatives for determining the exchangeable cations and the total cation exchange capacity of saline-calcareous-gypseous soils. Soluble salts are removed at a soil moisture content equivalent to a water tension of 0.001 atmosphere (pFo); for the determination of this energetically defined value a simple and easily reproducible procedure is given. The exchangeable Na, Mg, K, etc. are released by leaching with a calcium sulphate solution, the advantages of which against the ammonium acetate one are discussed in relation to determination of exchangeable Mg with exclusion of other sources, effectivity in the replacement of the adsorbed sodium and significance of the exchanged K in relation to its possible availability for plants. For the cation exchange capacity determination, the calcium saturated sample is put into contact with an ammonium oxalate solution which in these soils acquires a buffered reaction around pH 8,5. The difference in ammonium concentration is a measure of the cation exchange capacity as ammonium sorption (CEC_{as}), while the decrease in oxalate concentration — deducting the soluble sulphates and carbonates formed by reaction with gypsum and lime — represents the real cation exchange capacity (CEC). The importance of the possible differences between CEC_{as} and CEC is discussed.

Lunin, J., and Batchelder, A. R. CATION EXCHANGE IN ACID SOILS UPON TREATMENT WITH SALINE SOLUTIONS. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 507-515. 1960. (SWCRD, ARS, USDA, Norfolk, Va.)

Three soils were acidified with dilute HCl and then limed to give six different levels of base saturation. These soils were treated with several dilute saline solutions composed of mixtures of NaCl and $CaCl_2$. The data show that the SAR value of the saline solution $(Na^+/\sqrt{Ca^{++}/2})$ is an important factor in determining the amount of sodium adsorbed, but for a given solution, the amount of sodium adsorbed increased with increasing level of calcium saturation in the soil. After sixteen successive treatments of a given soil with a dilute saline solution, equilibrium between the soil and the initial solution composition was not attained. The degree to which equilibrium was attained was less at lower levels of base saturation than at higher levels. At the highest levels of base saturation, treatment with the saline solutions resulted in a decrease in exchangeable calcium as well as a slight decrease in exchangeable Na + Ca. These soils were predominantly kaolinitic.

Barshad, I. THE EFFECT OF THE TOTAL CHEMICAL COMPOSITION AND CRYSTAL STRUCTURE OF SOIL MINERALS ON THE NATURE OF THE EXCHANGEABLE CATIONS IN ACIDIFIED CLAYS AND IN NATURALLY OCCURRING ACID SOILS. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 435-444. 1960. (U. Calif., Berkeley, Calif.)

The composition of the exchangeable ions of naturally occurring acid soils was found to be affected by the total chemical composition of the clay minerals through an interchange reaction whereby adsorbed H^+ displaces octahedral and tetrahedral Mg^{++} and Al^{+++} to exchange positions. The rate and extent of this reaction are affected by the crystal structure by determining the ease of accessibility to octahedral and tetrahedral position at the interior of the crystal particles.

As a result of the interchange reaction of adsorbed H^+ with octahedral Mg^{++}, it is possible to explain why the exchangeable Ca^{++}/Mg^{++} ratio of soils with an increasing degree of soil development decreases rather than increases — as should be expected by the laws of the cation exchange reactions.

The exchangeable Ca^{++}/Mg^{++} ratio of soils tends to be lower the higher the MgO content; consequently soils high in vermiculite, biotite, chlorite, or chrysotile tend to have lower Ca^{++}/Mg^{++} ratios than soils high in montmorillonite, kaolinite, or halloysite.

The increased strength of binding of adsorbed Al^{+++} to the exchange spots with an increasing degree of hydroxylation is the cause for the 'reduction' of the 'base' exchange capacity and 'exchange acidity' of soils as determined by replacement methods using salts of strong acids and bases.

Interlayer expansion of Al-montmorillonites in the dry state as well as with water or glycerol is strongly affected by the degree of hydroxylation of the Al^{+++}.

The lower degree of hydroxylation of Al^{+++} which is adsorbed by vermiculite than by montmorillonite is believed to be the cause for the finding that under similar leaching conditions soils high in vermiculite tend to be lower in pH, in either water or a KCl solution, than soils high in montmorillonite.

Thomas, G. W. FORMS OF ALUMINUM IN CATION EXCHANGERS. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 364-369. 1960. (Va. Agr. Expt. Sta., Blacksburg, Va.)

It appears that the formation of either $Al(OH)_3$, $Al(OH)_2^+$, or $Al\ OH^{+2}$ can occur in Al-saturated exchangers treated with $Ca(OH)_2$ or lime. The form of the neutralization reaction seems to depend on the type of exchanger and on the experimental conditions. With soils, however, it is more likely that charged hydroxy-Al species are formed upon liming, especially at lower pH values. Thus, a given quantity of $Ca(OH)_2$ immobilizes more than an equivalent quantity of Al^{+3}.

Popenoe, H. SOME SOIL CATION RELATIONSHIPS IN AN AREA OF SHIFTING CULTIVATION IN THE HUMID TROPICS. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 303-311. 1960. (U. Fla., Gainesville, Fla.)

An investigation of basic soil properties and their inter-relationships under a wide range of ecological variables (elevation, rainfall, geology, soils, topography), was undertaken on shifting cultivation areas of the Polochic Valley in Guatemala. Certain fundamental relationships were revealed despite the wide variation in soil conditions. Soil pH is directly related to exchangeable Ca and inversely related to exchangeable Al, and exchangeable Ca is inversely related to exchangeable Al. No obvious relation exists between either cation exchange capacity or organic matter and any or all of the exchangeable nutrient cations, although these two properties are directly related to each other. The results indicate that the values for exchange capacity and organic matter in these soils are poor indicators of nutrient status and are not as useful as relations based on the permanent charge and pH characteristics of the soil.

Shoor, G. H. J. Van. LA COMPOSITION MINÉRALE DU COTONNIER EN FONCTION DE LA COMPOSITION ANIONIQUE ET CATIONIQUE DE L'ALIMENTATION. [MINERAL COMPOSITION OF COTTON AS A FUNCTION OF THE RELATIVE PROPORTION OF THE ANIONIC AND CATIONIC COMPOSITION OF THE NUTRITION.] Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 148-153. 1960. (U. Brussels, Brussels, Belgium.)

1. The equivalent contents, on dry matter, of cotton are expressed, for different organs, by a polynomial of the first degree as a function of the relative proportions of nutrients. There is distinguished:

a) an important primary positive action of the nutrient element of which the content is being studied,

b) positive or negative interactions of other elements, often inferior to the primary action.

2. The primary action and the interactions vary with the organ, the age and cultural conditions.

3. Anions act more on the cationic than on the anionic contents, and reciprocally.

4. Phosphorus acts by its action on the accessibility of certain nutrients.

5. Potassium interferes by its preferential penetration.

6. These effects are of a kind to have consequences on the interpretation of foliar diagnosis.

Moschler, W. W. CHANGES IN SOIL BASE STATUS INDUCED BY RATES OF GROUND DOLOMITIC LIMESTONE OVER A FIVE YEAR PERIOD. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 302-306. 1960. (Va. Agr. Expt. Sta., Blacksburg, Va.)

Changes in soil pH and base status of three soil types in Virginia were studied for a five year period following the application of four rates of dolomitic limestone. The three soils behaved rather similarly despite considerable range in texture. Reaction was essentially complete after two years. Percentage base saturation increased an average of approximately 2.6 per 0.1 increase in soil pH. Exchangeable Al was reduced to relatively low levels by two tons of dolomite per acre. Silt loam soils contained approximately twice the content of exchangeable Ca and Mg as sandy loams at approximately the same pH level and percent base saturation.

Wiklander, L. INFLUENCE OF LIMING ON ADSORPTION AND DESORPTION OF CATIONS IN SOILS. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 283-291. 1960. (Inst. Pedology., Royal Agr. Col., Uppsala, Sweden.)

It has been found both by theory and by experiments that increase in the degree of Ca-saturation by liming has a twofold effect on the cation exchange. On one hand it *favours adsorption of nutrient cations* by substitution of Ca for more firmly held H and Al, thus decreasing the concentration in the soil solution of cations other than Ca. This should be demonstrable after fertilization of soils with varying Ca status. Should Ca be more firmly held than H, as might be the case in very acid soils with low V_{Ca}, a slight liming may have a dissimilar effect which, however, must turn into the 'normal' one on further increase in V_{Ca}. On the other hand liming works in the opposite way to that stated above by *increasing the replacing power of* H *ion,* thus rendering adsorbed nutrient cations more available to plants and more easily lost by leaching. The latter is indicated by a 30 years old lime experiment at Lanna experimental farm. During this period the content of exchangeable Mg was reduced by 0.5 me./100 g. of topsoil in the plots that had received 12000 kg. CaO/ha when compared to the unlimed plots.

Yuan, T. L. SOIL ACIDITY AND ALUMINUM STATUS AS AFFECTED BY SOME NEUTRAL SALTS. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 152-160. (Fla. Agr. Expt. Sta., Gainesville, Fla.)

An investigation was made on the change of the soil pH, titratable acidity and the aluminum concentration from the exchange reaction when the soil was suspended in neutral salt solutions of different concentrations under limed and unlimed conditions. Among the thirteen salts studied, the cation effect followed the order of $Ba > Ca > K > Na > Mg$ when they were in the forms of chlorides and sulfates. The positions of sodium and magnesium reversed when nitrate was the anion. The relative effects of three anions tested were $SO_4 > NO_3 = Cl$. The results from the study of concentration effect showed that the more concentrated the salt solution, the lower was the pH and the higher the titratable acidity and aluminum concentration. Under the limed conditions the effect of the neutral salts at different concentrations persisted although in a much lesser degree.

Doeglas, D. J. SEDIMENTOLOGICAL DATA FOR SOIL MINERALOGY. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 534-547. 1960. (State Agr. U., Wageningen, the Netherlands.)

For petrographical studies of soils on sedimentary formations some knowledge of sedimentary processes and sedimentary petrology is necessary.

Sediments consist, due to laws of transport and deposition, of three main grades; gravel, sand and silt-clay. These groups are deposited separately and the sediments composed of more than one group are laminated.

During transport and deposition each group can be sorted, mainly by loss of coarse grains. In gravel and sand, however, the finest grains can be winnowed out during or after deposition. The middle portion of the size frequency distribution of sands and the finest portion of the silty clay remains intact. The ratios of the grades of these portions remain constant. Representation of size frequency distributions on a rectangular diagram enables us to see these constant ratios. Changes due to sorting can be partly eliminated and enrichment or loss of fine clay particles due to soil forming processes can be distinguished.

The size of a mineral in sediments depends on the size of that mineral in the source rocks. The mineralogical composition varies continuously from the coarse grades to the clay grade.

As silt-clay grades are transported much faster than sand, they may have different mineralogical compositions. For a check on the homogeneity of a soil profile the mineralogical analysis of one fine sand or silt grade is sufficient. For studies of soil genesis and soil fertility all grades should be studied by heavy and light minerals.

Sawhney, B. L. ALUMINUM INTERLAYERS IN CLAY MINERALS. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 476-481. 1960. (Conn. Agr. Expt. Sta., New Haven, Conn.)

The stability of the 14 Å spacing of a 'chlorite-like' clay mineral in soils is attributed to the formation of Al interlayers in the expanding layer silicates, vermiculite and montmorillonite. The amount and the stability of Al interlayers varies between soils and horizons. Al interlayers in soils developed from granite and gneiss (Gloucester) and micaceous schist (Charlton) are more pronounced and stable than in soils derived from basaltic trap rock (Holyoke) and limestone (Stockbridge). High content of organic matter and low pH inhibit the formation of Al interlayers in the surface horizon of Gloucester.

The extraction of Al interlayers produces an increase in cation exchange capacity. This increase was greater where Al interlayers were more pronounced and stable and was as much as 40 per cent.

Deuel, H. INTERACTIONS BETWEEN INORGANIC AND ORGANIC SOIL CONSTITUENTS. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 38-53. 1960. (Lab. Agr. Chem., Swiss Fed. Inst. Tech., Zurich, Switzerland.)

The soil is a complex mixture of numerous *I* (inorganic) and *O* (organic) compounds of small to large molecular weight or particle size. Many of these constituents are irregular heteropolymers, the constitution of which is not exactly known. In the soil, *I* and *O* compounds are continuously degraded and synthesized, and an endless number of interactions between the many compounds and organisms takes place. Thereby, not only *I—I* and *O—O*, but also *I—O* interaction products are formed.

These *I—O* products are soluble or insoluble depending on the chemical constitution of the components (particle size and form; kind, number and distribution of functional groups, etc.) and on the reaction conditions. The secondary particles of the *I—O* products consist of two to many *I* and O primary particles. In these products, the *I* and *O* constituents are held together by different bonds, very weak to very strong (van der Waals forces, hydrogen, ionic, coordinate, and covalent bonds). For the elucidation of the chemical architecture of *I—O* compounds, different, mainly indirect methods have been used, but more appropriate methods should be developed.

The *I—O* interactions are of great importance in many soil processes and soil properties. The influence of these interactions on transformations of *I* and *O* compounds, on transportation processes, on the availability of nutrient and growth substances, and on soil structure are discussed. Antithetical effects can be caused by *I—O* interactions, depending on the prevailing conditions, e.g., an increase or decrease in solubility, peptization or flocculation, transportation or immobilization, increase or decrease in availability to organisms, promotion or inhibition of degradation, and promotion or inhibition of synthesis of a given substance.

Alexandrova, L. N. ON THE COMPOSITION OF HUMUS SUBSTANCES AND THE NATURE OF ORGANO-MINERAL COLLOIDS IN SOIL. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 74-81. 1960. (Agr. Inst., Leningrad, U.S.S.R.)

1. Organo-mineral compounds and organo-mineral colloids are to be distinguished in the soil. Chemical forms of bond are characteristic for the first; the second being a complex of highly dispersed clay minerals, humus substances and their organo-mineral compounds in the state of 'coalescence'.
2. To organo-mineral compounds belong humus acid salts with cations of alkali and alkali-earth bases and complex alumo- and iron-humus derivatives. These organo-mineral compounds are formed as the result of exchange reaction between hydrogen of humus acid functional groups and exchangeable (or water soluble) cations and hydratized forms of non-silicate sesquioxides.
3. Alumo- and iron-humus substances are present in all the soils, their absolute amount and saturation degree with sesquioxides being different according to conditions and the character of soil formation.

Jacobs, D. G., and Tamura, T. THE MECHANISM OF ION FIXATION USING RADIO-ISOTOPE TECHNIQUES. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 206-214. 1960. (Health Physics Div., Oak Ridge Natl. Lab., Oak Ridge, Tenn.)

In the cases of illite, potassium-treated vermiculite, heat-treated bentonites, and micas, the 'fixed' cations are merely held with a high affinity by exchange sites at the edges of the interlayer spacing. In the case of vermiculite, on the other hand, the cations are physically entrapped by collapse of the lattice in a true fixation process. For this reason nearly all of the interlayer exchange sites of vermiculite are available for cation fixation, while only the exchange sites along the outer edges of the interlayer spacing of illite have the capability of fixing new cations introduced into the system. This accounts for the frequent observation that the fixation capacity of vermiculite is several times that of illite, even though the interlayer charge of vermiculite is less than that of illite.

These studies regarding the characterization of the cesium exchange reaction with the various clay minerals have implications beyond the immediate application to waste-disposal techniques. For example, the observation that 60 % potassium saturation of vermiculite (i.e., approximately 80 % of the sample being in the collapsed state) showed X-ray diffraction maxima at only 10 Å reveals the limitation of using X-ray diffraction techniques along for mineral characterization. Furthermore, the resolution of the further fixation capability of the 60 % saturated vermiculite by the radiochemical Cs^{137} technique permits quantitative characterization of cation fixation power of the mineral. This should be a powerful method for the proper identification of minerals in soils and sediments.

As clays do not show high specificity for strontium in vaste solutions (8), studies are now in progress with materials whose structure favors the sorption of strontium. Phosphatic minerals show much greater selectivity for strontium than do the clay minerals. The success to date suggest that structure is an important parameter in determining the selectivity of sorption of ions present in micro-quantities in soil solution.

Taylor, A. W. THE SIGNIFICANCE OF RATIOS OF ION ACTIVITIES. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 342-346. 1960. (Div. Chem. Develop., TVA, Wilson Dam, Ala.)

Experimental data are presented to show that a potassium-saturated clay has a definite potassium hydroxide activity which is characteristic of the degree of saturation of the sample and is independent of the potassium chloride concentration of the equilibrium solution in which it is measured. This is not true of the individual activities of the potassium and hydrogen ions in the suspensions, because these are dependent upon the salt concentration as well as the state of the clay. The activity of any individual ionic species, no matter how defined, is therefore insufficient to define the chemical status of a clay suspension; even in a homionic clay, it is not the only independent variable in the system.

Peters, D. B., and Russell, M. B. ION UPTAKE BY CORN SEEDLINGS AS AFFECTED BY TEMPERATURE, ION CONCENTRATION, MOISTURE TENSION AND MOISTURE CONTENT. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 457-466. 1960. (SWCRD, ARS, USDA, Urbana, Ill.)

The absorption of ions by plant roots from porous media is controlled in part by transport mechanisms affecting the flow of ions and water. The degree of the effect is controlled by the kind of porous media, being more pronounced in such media as sands and silts. Reductions in root elongation and in the uptake of ions and water occur in the range of soil moisture tension in which the most rapid changes in moisture content occur for a unit change in tension. The transport of ions to root surfaces is probably limited by the changing geometry of the water system as the moisture content changes. The final concentration of ions in roots is controlled by the initial concentration present and by the rate at which ions are transported to the root surface, either by diffusion or mass flow of water.

Knickmann, E., Leidenfrost, E., and Tepe, W. OPTIMALBEREICHE DER NÄHRSTOFFVERSORGUNG EINES BODENS FÜR 8 ELEMENTE, ERMITTELT DURCH IONENAUSTAUSCHER. [OPTIMUM RANGE OF THE NUTRIENT SUPPLY OF SOME SOILS FOR EIGHT ELEMENTS DETERMINED THROUGH ION EXCHANGE.] Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 45-52. 1960. (Aus dem Institut für Bodenkunde and Pflanzenernährung der Hess. Lehrund Forschungsanstalt für Wein-, Obst- und Gartenbau, Geisenheim, Rheingau, Germany.)

All the important nutrients should be taken into consideration in assessing fertilizer requirements for intensive farming. A single soil extract is desirable in which the elements occur in their natural relationship and can be quantitatively determined.

For this purpose a mixture of anion and cation exchangers has proved suitable. It is saturated with HCO_3^- or H^+ ions and filled into a dialysing skin which is left for 24 hours in a soil sample saturated with water, and the exchanged nutrients are then eluted, and determined in the usual way.

In this method the soil content of humus, clay and lime is comprehended, and does not require special consideration. The optional ranges for the supply of N, P, K, Ca, Mg, Na, Mn and S, and lower and upper limits for deficiency and excess are tabulated.

Wells, N., and Taylor, N. H. SOIL SEQUENCES AS AN AID IN SOIL AND PLANT CHEMISTRY. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 193-196. 1960. (Soil Bur., Dept. Sci. and Indus. Res., Wellington, New Zealand.)

With the aid of a genetic classification, soils from like parent rocks can be arranged in sequences according to their degree of weathering. Sequences of this kind illustrate the differences that occur between soils from different rocks. Weakly weathered soils from basalt inherit from the rock high amounts of Fe Mg Ca Ti P Cr Ni Co, those from andesite inherit high amounts of Sr Cu V Zn while those from rhyolite inherit low amounts of Fe Mg Ca Ti P Cr Ni Co Cu. Strongly weathered soils from the more basic rocks have very low levels of Na K Mg Ca Sr Ba resulting from losses by leaching and they have to a lesser degree accumulated Fe Ti Mo V Ga Al. In soils from acidic rocks vegetation can condition weathering: in topsoils of strongly podzolized (strongly weathered) soils the residual elements are Si Ti Zr.

Four of these sequences are described to illustrate the differences that occur between soils derived from like parent rocks — in secondary minerals, the total element content of P K Mo Cu in topsoils and in a grass, sweet vernal (*Anthoxanthum odoratum*) growing on the soils.

Cady, J. C. MINERAL OCCURRENCE IN RELATION TO SOIL PROFILE DIFFERENTIATION. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 418-424. 1960. (SCS, USDA, Beltsville, Md.)

Some examples have been given of the relationship between the physical and mineralogical composition of soil parent material and the mineral distribution which develops in soil profiles as a result of the soil forming environment. Soils without mineralogical differentiation are present in strongly weathered, relatively inert parent materials and in young, unweathered materials. Different mineralogy in different horizons is brought about by weathering as in the case of the Podzols and by movement of clay in the soils with textural B horizons. Soils with mineralogical profiles are generally found in parent material that has a variety of weatherable minerals throughout the depth in which the solum develops. Soils with textural profiles but without segregation of particular mineral species by depth are found in both well-weathered material and slightly weathered material.

Glenn, R. C. CHEMICAL WEATHERING OF LAYER SILICATE MINERALS IN LOESS-DERIVED LORING SILT LOAM OF MISSISSIPPI. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 523-531. 1960. (Miss. Agr. Expt. Sta., State Col., Miss.)

A study of a soil derived from Peorian Loess in Mississippi, Loring silt loam, revealed that the parent loess governed the mineralogy of the soil to a large extent, even though the climate was favorable for rapid weathering of minerals.

Large amounts of amorphous material, having a silica: alumina ratio close to that of kaolinite were present in the medium and fine clays. Kaolinite was present in fair amounts in the fine clay of the A_2 horizon but not in the C horizon. Severe weathering of iron-rich layer silicates in the surface weathering zone was noted. An aluminous chlorite of pedogenic origin was found in the fine silt of the A_2 and B_2 horizons of the soil.

Davis, J. F., Robertson, L. S., Jr., and Cook, R. L. EVALUATION OF RESIDUAL FERTILITY ON SOME GRAY-BROWN PODZOLIC, HUMIC-GLEY, AND ORGANIC SOILS. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 202-211. 1960. (Mich. State Agr. Expt. Sta., E. Lansing, Mich.)

The judicious use of phosphorus and potassium soil tests can eliminate the risk of losses from insufficient amounts of these nutrients in the production of a crop.

The complexity of factors and factor-interactions may restrict the degree to which soil tests and crop yield responses can be correlated.

Soil test results show that phosphorus and potassium levels are building up on soils where fertilizers are regularly being applied. Extremely high potassium levels lead to losses by leaching, luxury consumption by crops, intensification of magnesium deficiency, and a reduction or elimination of a response to sodium.

Changes in fertilizer technology have tended to eliminate or reduce the amounts of secondary and minor elements such as calcium, sulfur, zinc and boron contained in fertilizer. The neutralization of the equivalent acidity of nitrogen materials applied annually in the United States would require approximately 25 percent of the lime used. The total effects of these changes should be evaluated so that crop production in the future may not be decreased.

Residual benefits of copper may last several years. Boron and manganese become fixed in unavailable form and need to be applied each year where soil conditions and the crop grown require their use.

A marked soil type-time of application nitrogen interaction exists under Michigan climatic conditions.

Woodruff, C. M., and McIntosh, J. L. TESTING SOIL FOR POTASSIUM. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 80-85. 1960. (Mo. Agr. Expt. Sta., Columbia, Mo.)

A method of testing soils for potassium designed so as to determine whether or not a soil contains sufficient potassium to develop and mature an annual crop is described. The standard free energies for the replacement of potassium from the exchange complex of the soil at which nourishment of plants approaches and becomes critical have been chosen to define the availability of the potassium. By suitable choices of soil-solution ratios for equilibration, it becomes possible to determine whether or not the quantity of potassium required to develop and mature a crop may be removed without exceeding the energy of replacement necessary to nourish the crop with potassium. The results obtained by the method do not indicate the quantity of potassium that might be required as a fertilizer in the event that the soil is deficient in potassium.

Richard, T. A., Attoe, O. J., Moskal, S., and Truog, E. A CHEMICAL METHOD FOR DETERMINING AVAILABLE SOIL NITROGEN. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 28-35. 1960. (U. Wis., Madison, Wis.)

Results obtained with various soil nitrogen tests of 61 different soils were correlated with nitrogen uptake by corn grown in pots containing these soils. A method is proposed in which the nitrate nitrogen present in the soil is reduced and determined simultaneously with that released as ammonia by digestion with 0.25 N H_2SO_4. This method gave a higher correlation ($r = 0.865$) with the nitrogen uptake than methods based on rate of nitrification, total nitrogen or organic matter, and growth of *Aspergillus niger*.

By multiple regression analysis, one pound of nitrate nitrogen was found to be as effective in nitrogen uptake by the corn crop as three pounds of nitrogen released by digestion of the soil with 0.25 N H_2SO_4 in the proposed method.

Since the corn in this study became deficient in zinc, the need in pot experiments of adding this element, especially for corn, and possibly other trace elements is suggested.

Scott, R. O. THE APPLICATION OF DIRECT-READING SPECTROCHEMICAL METHODS OF SOIL ANALYSIS. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 10-15. 1960. (Macaulay Inst. Soil Res., Aberdeen, Scotland.)

The applications of two direct-reading spectrometers to the analysis of soils and plants are described. One is a two-channel instrument for the determination of magnesium in solution by the porous-cup spark method. The other is the eleven-channel Hilger Medium Direct Reader, the use of which is illustrated by the determination of Al, Cu, Mn and Zn in soil extracts by the porous-cup spark method. A tentative pelleted rotating disk method is also described for the determination of Zn, B, Mn and Cu in ashed plant materials.

Stelly, M., and Ricaud, R. CHEMICAL EXTRACTANTS AS A DIAGNOSTIC AID IN DETERMINING LEVELS OF 'AVAILABLE' SOIL PHOSPHORUS. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 60-71. 1960. (La. State U., Baton Rouge, La.)

The following general conclusions summarize the results presented.

1. The amounts of 'available' soil phosphorus measured chemically depended upon the choice of extracting solution and soil to solution ratio used.
2. The amounts of 'available' phosphorus by any one method and soil to solution ratio generally were highly correlated to values obtained with .03N NH_4F in .1N HCl at the corresponding ratio.
3. The amounts of 'available' phosphorus at one dilution usually were highly correlated to values given by another soil to solution ratio of the same extractant.
4. In assessing the laboratory adaptability of an extractant for routine use in a soil testing laboratory the magnitude and range of values for the variable being measured are of primary importance.
5. A solution of .03N NH_4F in .1N HCl at a 1 to 20 soil to solution ratio satisfied the requirements stipulated as desirable of a soil testing extracting agent for phosphorus.
6. The extractant adopted yielded differences in amounts of soil phosphorus between soils and for a given soil as a result of phosphorus fertilization practices.
7. Laboratory values for phosphorus by the adopted method were closely related to field and greenhouse yields of crops and to phosphorus uptake by plants in greenhouse investigations.
8. Chemical extractants can be used effectively to measure fertility levels of soil phosphorus. Their effectiveness is dependent on the efforts given to correlation of laboratory results with plant responses.

Nichols, D. J. D. DETERMINATION OF MINOR ELEMENT LEVELS IN SOILS WITH THE ASPERGILLUS NIGER METHOD. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 168-182. 1960. (Long Ashton Res. Sta., U. Bristol, Bristol, England.)

The advantages of the bioassay method for determining trace metals available in soils to higher plants include, (a) a quantitative method for levels of micronutrients that are often below the limits of detection of present-day chemical and physical techniques, (b) a direct method which involves the minimum preparation or dilution of the sample, (c) results that are in closer agreement with the response of higher plants to trace metals than those obtained with chemical extractants of the soils. The disadvantages include the need for rigorous pure culture methods and the frequent use of standard series for the trace metals to check that a mutation has not occurred in the organism. Nevertheless the method has been used to good effect to determine quantitatively minute amounts of trace metals in soils, plants and in enzyme preparations.

Muller, A., and Baren, F. A. van. SOIL ANALYSIS AND PHYSIOLOGICAL DIAGNOSIS. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 141-147. 1960. (Royal Tropical Inst., Amsterdam, the Netherlands.)

Two methods, soil analysis and physiological diagnosis (analysis of leaves or other parts of the plant), which are used to solve problems on the efficient use of fertilizers, are compared. The conclusion is drawn that there is no question of choice between both methods, but that because of the interrelationship between soil and plant they ought to complement each other.

Physiological diagnosis has to be seen as a 'long term project' which only can be carried out by research stations with a competent staff. However, a combined investigation of soil and of plant parts, carried out by specialists may give private planters valuable information on the condition of their plantations, in a relatively short time. This is illustrated by three examples.

Tyler, K. B., Fullmer, F. S., and Lorenz, O. A. PLANT AND SOIL ANALYSIS FOR POTATOES IN CALIFORNIA. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 130-140. 1960. (U. Calif., Riverside, Calif.)

Petiole analyses with soil analyses for potatoes have proven to be very effective tools which are being used with excellent results in California agriculture. Many commercial and grower laboratories as well as agricultural extension laboratories are routinely using these analyses successfully. These laboratories have been provided with the plant and soil deficiency ranges presented in this paper and find good agreement with the suggested levels.

Petiole analyses indicate the adequacy or inadequacy of the present and past fertilizer practices for a particular field. Although its use as a guide for fertilization of the current season's crop may be limited, especially in rapidly growing plants such as potatoes, the results can be effectively used as a guide to fertilization of subsequent crops on the same field.

Where no previous leaf analyses information for a given field is available, soil tests for phosphorus and potassium can be used to determine their requirements for the next crop. However, since soil tests for nitrate-nitrogen in our western soils are unreliable, the nitrogen program must be based on general nitrogen requirements of the crop in that area.

Falloon, J. THE DIAGNOSTIC APPROACH USED BY COUNTY AGENTS IN MISSOURI. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 123-129. 1960. (Ext. Serv., U. Mo., Columbia, Mo.)

Plant tissue and field soil tests aid materially in diagnosing certain nutrient deficiencies in plants. Tissue tests are made for nitrate nitrogen, phosphorus and potassium. Field soil tests are made for pH and phosphorus.

These tests are *supplements* nor *substitutes* for laboratory soil tests. They should not be used as a guide as to *how much* fertilizer to apply.

Plant tissue and field soil tests are easy to run. They are made right out in the field and it takes only a few minutes to run them. The equipment and supplies required are simple and easy to carry in the field.

Information gained from these tests can be used in two ways. One is to help the individual farmer and the other is to give the basis for a group program.

County Extension offices in 78 of the 114 counties are equipped to run these tests.

Dumenil, L., Hanway, J. J., and Pesek, J. T. EVALUATION OF RESIDUAL FERTILIZER EFFECTS BY CHEMICAL COMPOSITION OF PLANT PARTS. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 212-219. 1960. (Iowa State U. Sci. and Tech., Ames, Iowa.)

A method is presented by which the changes in N and P concentrations in the corn (*Zea mays*) leaf can be used to estimate the levels of residual N and P from fertilization in a previous year. Relationships between the changes in per cent N and per cent P in the corn leaf and four variables, quadratic functions of N and P fertilizer levels and of per cent N and per cent P levels in the leaf from the unfertilized treatment plus all two-factor interactions, were determined from 93 fertilizer experiments by multiple curvilinear regression analyses.

From the two regressions, residual quantities of N and P fertilizers can be estimated from the N and P concentrations in the leaf from unfertilized corn and from corn fertilized previously. Since the N and P fertilizers and their interaction had significant effects on both dependent variates, residual levels of both nutrients are estimated by solving the two equations simultaneously by a graphical method.

McLean, E. O., Shoemaker, H. E., and Hourigan, W. R. SOME EFFECTS OF ALUMINUM ON LIME REQUIREMENT TESTS OF SOILS. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 142-151. 1960. (Ohio Agr. Expt. Sta., Wooster, Ohio.)

Fourteen Ohio soils with varying amounts of acidity and extractable Al were treated with increasing rates of $CaCO_3$ and moist incubated for 17 months. For comparison, the amounts of acidity of these soils following incubation were determined by the Mehlich buffer, the Woodruff buffer, the Shoemaker, McLean, and Pratt buffer, and $Ca(OH)_2$ titration methods.

The Woodruff method used according to published procedure, indicated only about half the amont of aicidity indicated by $CaCO_3$ addition + incubation. However, this buffer indicated too much acidity in partially limed soils. The Mehlich buffer indicated the correct amount of acidity in unlimed soils. When adjusted by deducting the acidity neutralized by the buffer above pH 6.8 and adding to it the extractable Al, the Mehlich buffer indicated the amount of acidity regardless of liming. The Woodruff and Mehlich buffers appeared to be too strong to indicate by change of pH the relatively weaker acidity of soils high in extractable Al. The new Shoemaker, *et al.* buffer is much weaker and indicated the actual acidity of the soils very well, i.e. $r = 0.97$. Another group of 101 soils gave an equally good correlation between total acidity by the $Ca(OH)_2$ titration method and that obtained with the new buffer Method.

Nye, P. H., and Foster, W. N. M. THE USE OF RADIO-ISOTOPES TO STUDY PLANT FEEDING ZONES IN NATURAL SOIL. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 215-222. 1960. (U. Col. Ghana, Legon, Ghana, Africa.)

The relative amounts of a nutrient element derived from different parts of a plant's root zone may be determined by comparing the activities of a range of similar test plants, each of which is injected with tracer in a different part of its root zone. It is important to use carrier-free tracer, and to make allowance for variation in isotopic dilution at successive soil depths.

In experiments with P^{32} on a soil whose phosphorus characteristics are widely represented in West Africa, maize and pigeon pea obtained over 90 % of their phosphorus from the top 10 in. of soil. Trials indicated that in spite of radioactivity and physical disturbance at the point of injection valid results are obtained. It was found that at a late stage of growth the specific activity of tissue samples within a single test plant varies according to the amount of tracer being adsorbed at the time the tissue is elaborated. Comparison of plant activities based on sampling procedures need to take account of this.

Fried, M. THE USE OF ISOTOPES IN BASIC SOIL-PLANT RELATIONSHIPS RESEARCH. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 197-205. 1960. (SWCRD, ARS, USDA, Beltsville, Md.)

A generalized picture of ion uptake from the soil into the plant top is described in the following equation:

$$\begin{tikzcd}[column sep=large]
M\begin{pmatrix}\text{soil}\\ \text{solution}\end{pmatrix} \arrow[r, harpoon, shift left, "\substack{\text{diffusion}\\ \text{bulk movement}}"] \arrow[r, harpoon', shift right, <-] \arrow[d, shift right, <-] \arrow[d, shift left] & M\begin{pmatrix}\text{vicinity}\\ \text{of root}\end{pmatrix} \arrow[r, harpoon, shift left, "\substack{\text{passive}\\ \text{active}}"] \arrow[r, harpoon', shift right, <-] & M\begin{pmatrix}\text{inside}\\ \text{root}\end{pmatrix} \arrow[r, harpoon, shift left, "\text{phloem}"] \arrow[r, harpoon', shift right, <-] & {} \\
M(\text{soil}) & & & \xrightarrow{\text{xylem}} M(\text{tops})
\end{tikzcd}$$

Over any short period of time, a steady state exists in the overall process and the process may be rate limiting at one or more of the transfer points.

The rate of dissociation of the major nutrient ions into the soil solution is undoubtedly a much faster process than any of the other steps. Thus, the soil and soil-solution are essentially at equilibrium. The rate that ions reach the vicinity root generally reflects ion movement with the water stream although diffusional movement also may be a factor. Finally, uptake of the ion by roots and shoots probably goes through an active process in the roots which for shoots is followed primarily by xylem transport to the shoot.

Murdock, J. T., Corey, R. B., Bhure, N. D., and Waugh, D. L. SPECIAL TECHNIQUES FOR THE USE OF RADIOISOTOPES IN SOIL AND FERTILIZER RESEARCH. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 526-534. 1960. (U. Wis., Madison, Wis.)

The relative availabilities of monocalcium phosphate (MCP), dicalcium phosphate (DCP), calcium metaphosphate (CMP), calcium pyrophosphate and various mixtures of these materials were determined by short term uptake procedures. Autoradiographic studies were used to measure the rate and extent of phosphate movement from fertilizer bands containing these materials and the movement appeared to be well correlated with crop uptake values.

Radiotracer techniques were also used to study the ability of various crops to recover nutrients from the subsoil. Since the method involved the use of labeled phosphorus injected into various subsoil horizons, the recovery of this material would be effected by factors such as differential fixation, channeling of the injected solution and moisture content. Greenhouse and autoradiographic techniques were used to study the effects of some of these factors.

Petersburgsky, A. V. POTASSIUM IN THE ACID SOD-PODZOL SOIL IN CONNECTION WITH PECULIARITIES OF THE CROPS CULTIVATED. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 92-98. 1960. (K. A. Timiriazev Agr. Acad., Moscow, U.S.S.R.)

In bare continuous fallow a considerable migration of potassium (from that applied with fertilizers) to sub-plough horizon reaching approximately 20 % was established. About 15 % of potassium applied, apparently, moves even below the 40 cm layer. The loss of potassium is particularly large on the plot devoid of phosphorus fertilizers (NK plot) amounting to 42.3 %.

Fixation of potassium (transformation into unreplaceable form) occurs in the plough layer and constitutes 11—14 % of applied potassium, on PK and NPK plots fixation of potassium rises up to 33—35 %.

Winter rye utilizes intensively potassium applied, and, with exception of K plot, an additional absorption of potassium from soil takes place its magnitude depending on accompanying fertilizers; on NPK and NK plots 19—21 kg/hectare a year and on PK plot only 1.4 kg; application of potassium alone results in its partial fixation by soil in a non-exchangeable form (on the average 8.2 % annually).

Potatoes also fully utilize potassium applied with fertilizers and, above all, absorb potassium from soil resources in the amounts (kg/hectare, on the average, pro year): NPK plot — 18.7; PK plot — 17.3; NK plot — 4.6. A marked impoverishment in potassium content of sub-plough horizon of soil was observed. Fixation of potassium in the unreplaceable form takes place on K plot and on the average reaches 8.9 % of applied potassium for a year.

MacLean, A. J. WATER-SOLUBLE K, PER CENT K-SATURATION, AND $pK-\frac{1}{2}p$ (Ca + Mg) AS INDICES OF MANAGEMENT EFFECTS ON K STATUS OF SOILS. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 86-91. 1960. (Soil Res. Inst., Canada Dept. Agr., Ottawa, Ontario, Canada.)

Concentration of potassium in solution, $pK-\frac{1}{2}p$ (Ca + Mg) ratios and per cent K-saturation of 27 Ontario surface soils were compared with uptake of potassium by plants in pot tests. These criteria reflected differences in past management of soils, but such measurements only were not satisfactory for assessing potassium supply in soils varying in amounts of non-exchangeable forms of potassium which contribute to plant uptake.

In another experiment comprising 11 Canadian surface soils, cropping reduced the intensity of soil potassium. Addition of potassium increased the concentration of potassium in solution and per cent K-saturation, and reduced the $pK-\frac{1}{2}p$ (Ca + Mg) ratios, the magnitude of the change depending on past management and capacity of the soil to hold potassium in non-exchangeable forms. K_2CO_3 gave lower concentrations of potassium in solution than obtained with KCl, but there was no anion effect on $pK-\frac{1}{2}p$ (Ca + Mg) ratios.

Scott, A. D., and Hanway, J. J. FACTORS INFLUENCING THE CHANGE IN EXCHANGEABLE SOIL K OBSERVED ON DRYING. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 72-79. 1960. (Iowa State U., Ames, Iowa.)

An increase in exchangeable K is observed when many soils are dried. Most of this release of K occurs in the clay fraction. The amount of release observed on drying soils, however, varies with degree of drying, soil type, depth of the sample in the profile and extractant employed. Also, with

KCl additions less release and even fixation of K may be observed on drying. The processes involved in this release of K are partially reversible, thus, less release is observed if the dried soil is rewet before the K is extracted.

Alten, F., and Werner, W. NEUERE ERGEBNISSE ÜBER DIE Mg-BEDÜRFTIGKEIT DER BÖDEN UND ZUR WIRKUNG EINER Mg-DÜNGUNG. [NEW DATA ON THE Mg-REQUIREMENTS OF SOILS AND ON THE EFFECT OF A Mg-FERTILIZER.] Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 260-270. 1960. (Landwirtschaftliche Forschungsansalt Büntehof, Hannover, Germany.)

A review is made of the Mg-supplying status of German agricultural soils. Extensive soil studies have shown that the Mg status depends not only on the geological origin and the genetic evolution of soils, but also very strongly on factors like the exchange capacity, humus content and pH value.

The uptake and effect of Mg are influenced by different ions. Although such ion interactions generally have no influence on yields on normally buffered soils with adequate colloid content, it is nevertheless necessary to take them into consideration under extreme conditions, especially in unbuffered soils or soils with poor nitrification. In pot experiments with oats on unlimed and limed quartz sand the effect of Mg fertilizing in relation to the form and amount of N fertilizing and the amount of K fertilizing, as well as the form of Mg used, was investigated. The results of these experiments are presented and discussed.

Lamm, C. G. SOME INVESTIGATIONS OF THE CHEMISTRY AND PLANT UPTAKE OF MANGANESE IN SOILS BY USE OF RADIO ACTIVE MANGANESE^{-54}. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 223-229. 1960. (State Lab. Soil and Crop Res., Lyngby, Denmark.)

The chemistry of manganese in a sand, a loam and an organic soil was studied by means of radioactive Mn^{-54}. The specific activity of plants grown on these soils showed a temporary increase after the addition of labelled manganese sulphate followed by a decrease during the following weeks asymptotically leading to a state of isotopic equilibrium between soil- and fertilizer manganese. This was explained by assuming an initial rapid fixation of the added manganese followed by a slow isotopic exchange between soil and fertilizer manganese. The rate of isotopic exchange varied with the soil type and was correllated to the partial free molar energy necessary to desorb soil manganese. These facts must be considered in evaluation of the L- or A-values.

Grunes, D. L. NITROGEN AFFECTS THE RELATIVE AVAILABILITY OF SOIL AND FERTILIZER PHOSPHORUS TO PLANTS. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 307-313. 1960. (SWCRD, ARS, USDA, Mandan, N. Dak.)

In an experiment with barley in a controlled light-temperature plant growth chamber the additoin of N fertilizer markedly increased the proportion of the total plant P coming from the fertilizer.

The effect of N on increasing the relative absorption of banded fertilizer P appears to be associated with increased top and root growth, increased total absorption of P, and decreased soil pH.

Balba, A. M. PHOSPHORUS AND NITROGEN UPTAKE AS EXPRESSED BY A MITSCHERLICH-TYPE EQUATION. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 154-160. 1960. (U. Alexandria, Alexandria, Egypt, U.A.R.)

The response of onion plants to P and/or N increments was expressed by the following equation:

$$y_{N,P} = 29.4 \ (1—10^{-0.0969\ (4.1+x_N)})\ (1—10^{-0.03(8.74+x_P)})$$

In this equation the soil nutrients (the Mitscherlich 'b') is expressed in the added fertilizer units (x). The quotient $b/b + x$ is considered to represent the proportion of nutrient in the plant derived from the soil. This ratio was used to calculate the soil and fertilizer contribution to the plant nutrient content. The following conclusions were shown:

Without N application, the N content of the plant is close to the amount of the soil N calculated in the equation. The applied N is almost totally absorbed by the plants. Only the first increment of P increased the soil N in the plants.

The plant P content, without P application was only a fraction of the soil P content as calculated in the equation. Only 30—50 per cent of the applied P was taken up by the plants. N increments increased the P uptake. The differences between P and N uptake can be better understood on the basis of the nutrient mobility concept introduced by Bray.

Caldwell, A. C. THE INFLUENCE OF VARIOUS NITROGEN CARRIERS ON THE AVAILABILITY OF FERTILIZER PHOSPHORUS TO PLANTS. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 517-525. 1960. (U. Minn., St. Paul, Minn.)

The effects of nitrogen on the absorption of phosphorus by corn from P^{32} labelled materials were studied. Salts such as NH_4NO_3, $(NH_4)_2SO_4$ and NH_4Cl increased phosphorus absorption from superphosphate greatly, but only when nitrogen and phosphorus sources were intimately mixed together. Nitrogen in monoammonium phosphate and in ammoniated superphosphates also increased the absorption of phosphorus. Salts such as $Ca(NO_3)_2$ and $NaNO_3$ mixed with superphosphate did not increase phosphorus absorption. Significant increase in uptake of phosphorus did not occur when ammonium nitrate was mixed with calcium metaphosphate or di-or tricalcium phosphates. In mixtures of NH_4NO_3 and superphosphate ratios of N to P_2O_5 of 1 : 4 or narrower had to be achieved before significant incresae in uptake of phosphorus occurred.

It is suggested that effects of nitrogen on phosphorus absorption were brought about by chemical interactions between nitrogen and phosphorus salts rather than physiological effects of nitrogen on the plant.

Barber, S. A. THE INFLUENCE OF MOISTURE AND TEMPERATURE ON PHOSPHORUS AND POTASSIUM AVAILABILITY. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 435-442. 1960. (Purdue U., Agr. Expt. Sta., Lafayette, Ind.)

The response of corn (*Zea Mays*) to applications of phosphate and potassium varied from year to year because of climatic conditions. This was apparently due to changes in the availability of soil phosphorus and potassium. A relation was found between potassium availability and seasonal rainfall. The lower the rainfall the less available was soil potassium except that with excessive rainfall availability was also low.

Laboratory studies indicated that moisture level did not affect the rate of release of non-exchangeable potassium. Temperature increased the rate of release.

Laboratory studies indicated that an increase in incubation temperature of the soil increased the subsequent availability of soil phosphorus to millet. Moisture level had no effect. In field experiments there was some relation between the mean temperature and phosphorus availability. An example of the utilization of climatic-fertilizer response data is given.

Watanabe, F. S., Olsen, S. R., and Danielson, R. E. PHOSPHORUS AVAILABILITY AS RELATED TO SOIL MOISTURE. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 450-456. 1960. (SWCRD, ARS, USDA, Fort Collins, Colo.)

The relative uptake of P by corn seedlings was 100, 94, 80, 50 and 35 for 1/3, 1/2, 1, 3 and 9 bars soil moisture tension, respectively. Uptake of P increased linearly as soil moisture content increased for a given soil. Physical factors related to thickness of moisture films and diffusion path length appeared to control P uptake as well as physiological changes in the roots as moisture tension increased. Uptake of P at constant moisture tension on soils differing in texture was a linear function of solution P concentration. Corn roots absorbed several times more P per hour from a well-stirred solution than from a soil-root system, suggesting that the soil introduces a limiting factor in rate of P uptake.

Williams, E. G. SOME ASPECTS OF PHOSPHATE RETENTION AND AVAILABILITY IN SOILS. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 604-611. 1960. (Macaulay Inst. Soil Res., Aberdeen, Scotland.)

The phosphorus relationships in acid surface soils derived from contrasting glacial tills in north-east Scotland show marked effects of parent material which hinge ultimately on varying contents of acid-oxalate soluble Al and Fe. The phosphate retention capacity ranges from 0.5 to 3.0 per cent P_2O_5 and depends mainly on soluble Al, but it is also significantly correlated with acid-oxalate soluble Fe and with loss on ignition and carbon. The latter relationships derive mainly from strong Al-C correlations, and major proportions of the active Al, and possibly Fe also, probably occur in intimate association with organic matter. Phosphorus content is significantly correlated with retention capacity. The degree of saturation gives a significant criterion of phosphate status, and organic phosphates like inositol hexaphosphate probably fulfill an useful function by partially satisfying the retention capacity. High retention capacity is associated with lower crop responses but relatively higher effectiveness of placed compared with broadcast phosphate.

Olsen, S. R., Watanabe, F. S., and Cole, C. V. PHOSPHATES IN CALCAREOUS SOILS AS AFFECTED BY NEUTRAL SALTS. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 397-403. 1960. (SWCRD, ARS, USDA, Fort Collins, Colo.)

1. The exceptional behavior of sulfate salts on P solubility of calcium phosphates is explained on the basis of associated ion-pairs or undissociated

molecules of $CaSO_4$. When this effect is considered, sulfate salts act like chloride salts.

2. Variations in Ca, pH, and ionic strengths accounted for the observed changes in P solubility as influenced by various salts on dicalcium phosphate, hydroxyapatite, and calcareous soils.

3. Neutral salts exhibit opposite effects on the P solubility of a calcareous soil and $CaHPO_4.2H_2O$ mixed with calcite. In both cases, Ca concentration increases but the change is greater with the soil because of cation exchange between the salt and exchangeable Ca in the soil.

Lindsay, W. L., and Taylor, A. W. PHOSPHATE REACTION PRODUCTS IN SOIL AND THEIR AVAILABILITY TO PLANTS. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 580-589. 1960. (Agr. and Chem. Develop., TVA, Wilson Dam, Alabama.)

When water-soluble phosphate fertilizers dissolve, the solution which is released reacts with the surrounding soil to precipitate a wide range of new phosphate compounds. The particular phosphate formed depends upon the composition of both the fertilizer and the soil.

When well-characterized synthetic preparations of several of these compounds were tested in the greenhouse as sources of phosphorus for plants, marked differences were found. In general, these products which precipitate most readily are also most available to plants. These include $CaHPO_4.2H_2O$, $CaHPO_4$, $CaFe_2(HPO_4)_4.5H_2O$, $(NH_4,K)_3Al_5H_6(PO_4)_8.18H_2O$ (taranakite), and colloidal ferric and aluminum phosphates which precipitate from acidic phosphate fertilizers; $MgNH_4PO_4.6H_2O$ (struvite), $K_3CaH(PO_4)_2$ and $Ca_4H(PO_4)_3.3H_2O$ (octocalcium phosphate) from alkaline fertilizers; and $Ca(NH_4)_2P_2O_7.H_2O$ and $Ca_3(NH_4)_2(P_2O_7)_2.6H_2O$ from condensed phosphate fertilizers.

Phosphate reaction products which are only slightly available to plants are also formed in soils either as initial products or as a result of subsequent transformations of these products. Generally such phosphates are much more stable in the soil environment and persist for long periods of time and release their phosphorus only very slowly. These include $KFe_3 H_8(PO_4)_6.6H_2O$, $FePO_4.2H_2O$ (strengite), $Ca_{10} (PO_4)_6(OH)_2$ (hydroxyapatite), $Ca_{10} (PO_4)_6F_2$ (fluorapatite), and basic iron and aluminum phosphates of the type $K(Al, Fe)_2(PO_4)_2OH.2H_2O$ as well as $Ca_2P_2O_7.2H_2O$ which occurs as a subsequent product from condensed phosphate fertilizers.

The formation and distribution of these reaction products in the soil are believed to be important factors in determining the efficiency of different phosphate fertilizers.

Stanford, G., and Bouldin, D. R. BIOLOGICAL AND CHEMICAL AVAILABILITY OF PHOSPHATE-SOIL REACTION PRODUCTS. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 388-396. 1960. (Jr. Author, TVA, Wilson Dam, Alabama.)

Biological and chemical methods of evaluating sources of fertilizer phosphorus were compared. Two granule sizes (—6+14 and —40+60 mesh) of two chemical compounds (monoammonium phosphate and diammonium phosphate) were mixed with two soils (Hartsells fine sandy loam, pH 5.2, and Webster silty clay loam, pH 8.2) and the plant response obtained in greenhouse experiments was compared with the phosphorus extracted by three chemical extractants (0.025 N HCl—0.03N NH_4F, 0.5M $NaHCO_3$, and anion exchange resin).

When all sources of fertilizer phosphorus in both soils were considered, the fraction of the variation in plant uptake explained by extractable phosphorus was 40 %, 30 %, and 14 % for the HCl-NH_4F, resin, and $NaHCO_3$ methods, respectively. It was concluded that the chemical extractants used in these experiments are not particularly useful in fertilizer evaluation studies.

Moorthy, B. R., and Subramanian, T. R. PHOSPHATE POTENTIAL AND PHOSPHATE ION ACTIVITY IN SOILS WITH SPECIAL REFERENCE TO PHOSPHATE AVAILABILITY. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 590-599. 1960. (Indian Agr. Res. Inst., New Delhi, India.)

Using the total thermodynamic potential of a nutrient instead of the usual soil test values would reduce the error in correlation of soil test values with crop responses due to heterogeneity of soil population caused by the varying nature of the reactive soil complex. But unless some approximations and conventions are used, this potential cannot be measured easily in practice, one of such procedures is that employed in obtaining the Schofield's phosphate potential (S.P.P.). Another called here the equilibrium phosphate potential (E.P.P.) could be got by equilibrating a soil with small but graded amounts of mono-calcium phosphate solution of the order of the rate of phosphatic fertilization in the field scale and determining the initial mono-calcium phosphate potential in solution which would not undergo any change in this value after equilibration.

The highest correlation was found for crop responses to phosphatic fertilization by paddy on ten soils varying more widely in their nature with E.P.P. than with Schofield's phosphate potential, equilibrium phosphate ion activity Bray's P, Olsen's P, P-desorption capacity and P-sorption capacity and anion exchange capacity indicating that the approximations made in considering equilibrium phosphate potential as the available P are nearer the ideal than those in the others studied.

Huffman, E. O., Cate, W. E., Deming, M. E., and Elmore, K. L. RATES AND MECHANISMS OF DISSOLUTION OF SOME IRON AND ALUMINUM PHOSPHATES. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 404-412. 1960. (Div. Chem. Devlpmt., Wilson Dam, Alabama.)

A study was made of the rates and mechanisms of solution of phosphorus from complex iron and aluminum phosphates containing potassium, ammonium, or calcium; strengite and colloidal iron and aluminum phosphates; and dicalcium phosphate; all soil-fertilizer reaction products. Upon dissolution, the complex phosphates deposited colloidal phosphates that behaved like the tertiary phosphates of iron and aluminum which hydrolyzed slowly in water. On a scale of relative rates of solution of phosphorus in water, with strengite taken as unity, the tertiary phosphates ranged from 1 to 3, the complex phosphates ranged from 10 to 165, and dicalcium phosphate was 250. The dissolutions of the iron and aluminum phosphates were too slow to be affected by diffusion, and the surface areas of all the phosphates had a marked effect on their gross rates of solution. There is a marked chemical similarity between strengite and colloidal ferric phosphate.

Burau, R. G., White, R. G., and MacGregor, J. M. UPTAKE OF APPLIED IRON BY SOYBEANS FROM CALCAREOUS SOIL TREATED WITH PEAT-BASED HUMATES AND SYNTHETIC CHELATES. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 544-553. 1960. (U. Minn., St. Paul, Minn.)

A greenhouse experiment was designed to evaluate soybean uptake of iron added to a calcareous soil as soluble derivatives of the humate component of peat as compared to added iron uptake from ferric chloride and two iron chelates, EDDHA-Fe and HEEDTA-Fe. Fe^{59} was included in each treatment solution at the rate of 40 μc per greenhouse pot.

Radioanalyses of plant tops four weeks after treatment showed that concentrations of total added iron were essentially the same from both the humate derivatives and from ferric chloride applied as an acid solution when compared at the same rate. Plant concentrations of total added iron increased with increasing rate of application, but concentrations of radioiron did not change, indicating no change of recovery efficiency over the 20 to 80 pp2m Fe application rate range.

Recovery efficiency, which was greatest for synthetic iron chelates, increased significantly with increasing rate at lower rates of synthetic chelate application.

DeKock, P. C. THE EFFECTS OF NATURAL AND SYNTHETIC CHELATING SUBSTANCES ON THE MINERAL STATUS OF PLANTS. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 573-579. 1960. (Macaulay Inst. Soil Res., Aberdeen, Scotland.)

The fertilizing effect of a lignite has been related to its chelating effect on iron which is then rendered available for absorption by the plant. A study has been made of synthetic chelating substances in relation to their growth promoting effect. This has been described to the stability of the chelate molecule, the greater the stability, the more effective the growth promoting effect of the chelating agent. This means that the whole chelate is taken into the root, the iron or other chelated metal being subsequently liberated by metabolic processes. The chelating substances affect the mineral composition of the plant in so far as they cause an improvement in the iron status of the plant with associated changes in the phosphorus, potassium and calcium contents of the plant.

Seatz, L. F. ZINC AVAILABILITY AND UPTAKE BY PLANTS AS AFFECTED BY THE CALCIUM AND MAGNESIUM SATURATION AND PHOSPHORUS CONTENT OF THE SOIL. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 271-280. 1960. (U. Tenn., Knoxville, Tenn.)

Several pot experiments were conducted in a controlled environment room to study the effects of liming and soil pH, magnesium, phosphorus, and zinc additions on the incidence of zinc deficiency and zinc uptake by susceptible plants growing on Hartsells and Maury soils.

Yields of flax and sorghum were reduced as the lime rate was increased from 2 to 8 tons per acre and the soil pH was raised from 5.7 to 7.8.

When $CaCO_3$ and $MgCO_3$ liming materials were substituted in various proportions optimum growth was found at a ratio of 5/1 without zinc fertilization, and 1/1 for flax and 2/1 for sorghum when zinc was supplied. Zinc response was less when an optimum amount of magnesium was present than when magnesium was not supplied.

Extremely high rates of monocalcium and tricalcium phosphate were applied in combination with magnesium and zinc. The acidifying effect of monocalcium phosphate reduced the response from zinc fertilization. Zinc response did increase when tricalcium phosphate was added at rates of 5,000 pounds P_2O_5 per acre and above.

The implications of these findings are dicussed briefly.

Dobrzański, B. INFLUENCE OF THE PARENT ROCK AND OF UTILIZATION OF THE LAND ON THE MOBILE ALUMINUM CONTENT IN THE SOIL. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 171-177. 1960. (Dept. Soil Sci., Agr. Col., Lublin, Poland.)

Our Department has conducted research on mobile aluminum for several years.

About 1000 soil samples were taken from more than 300 soil profiles spread over the whole territory of Poland.

Mobile aluminum was determined by the frequently used method of Sokolov.

Soils formed from the sandstone of the Carpathian flysch contained the greatest quantity of mobile aluminum (to 117 mg/100 g of soil). Smaller quantities of mobile aluminum were found in soils formed from glacial deposits and water-derived formations.

Soils under forests, and especially under coniferous forests contain much more mobile aluminum than identical soils covered by perennial meadow or pasture vegetation, and above all than when used as arable land.

Fertilizing experiments conducted over the period of 40 years have shown that fertilization influences the content of mobile aluminum in the soil. An especially marked increase of the mobile aluminum content can be observed after dressing with ammonium sulphate.

The results of the present investigations confirm the need of further special research work on the mechanism and activity of mobile aluminum in soils.

Huseinov, D. M. THE INFLUENCE OF ORGANIC COMPOUNDS OF PETROLEUM ORIGIN UPON THE GROWTH OF ROOTS AND CROP CAPACITY OF AGRICULTURAL PLANTS. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 253-259. 1960. (Inst. Pedology and Agr. Chem., Acad. Sci. Azerbaijan, Baku, Azerbaijan, S.S.R.)

By our investigations it has been established that the naphthenic acids contained in petroleum industry wastes are the stimulants of plants growth.

The experiments have shown that the naphthenic acids obtained from gasoline refining give more coleoptile bends of oat sprouts, than heteroauxin and hybberellic acid.

The numerous tests carried out in Azerbaijan have shown the crop capacity increase (from 20 to 50 %) of vegetable cultures, cotton, tea and winter wheat due to the application of petroleum growth helping substance (from 50 to 300 g./hectare) in the mixture with mineral fertilizers.

The analyses of plant and soil samples taken from the experimental allotments have shown the increase of utilization coefficient of mineral fertilizers brought into soil under the influence of small doses of naphthenic acids.

Moore, A. W. THE INFLUENCE OF ANNUAL BURNING ON A SOIL IN THE DERIVED SAVANNA ZONE OF NIGERIA. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 257-264. 1960. (U. Col., Ibadan, Nigeria.)

Soils from a burning experiment in derived savanna of Nigeria were analyzed thirty years after its establishment. Fire may affect the soil directly through elevated temperatures and desiccation or indirectly through vegetation changes. Lower values for fine-particle percentages, total and nitrifiable nitrogen and cation exchange properties in the fiercely-burnt plot are related to greater destruction of vegetation and litter which occurs when burning follows desiccation by the harmattan. The higher carbon:nitrogen ratios, available phosphorus and saturation percentages of the lightly-burnt plot as compared with the protected plot are in keeping with the more savanna-like character of the former.

The results indicate the importance of time of burning on soil fertility in indigenous systems of agriculture. Light burning is not deleterious; in fact, some improvement in fertility may result from burning early in the dry season. Late (fierce) burning, however, results in lower fertility.

Baldanzi, G. BURNING AND SOIL FERTILITY. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 523-530. 1960. ('Conselho Nacional de Pesquisalls'; Estaçào Experimental de Curitiba, Brazil.)

The burning of plant residue before cultivation is a common farming practice in the tropics as a condition imposed by the peculiar characteristics of the regions of low latitudes. In an ambient lacking in climatic phenomena which limit the vegetation of the plants, the ground is always covered and protected from the damages that climate might originate, and the continuous and abundant accumulation of residue maintains in the soil a high organic matter content, although qualitatively poorer than that of the soils in temperate climates. Ploughing under a great mass of dry grass residue (about 10—15 ton/ha) of high C/N relation immediately before sowing causes a depression in crop production and does not benefit the fertility of the soils. Of the two alternatives (burning off or ploughing under) for making use of the plant residue, burning appears advisable. Nitrogen fertilization is not very efficient and often not economical. After three years of experimentation no significant decrease or increase of carbon or nitrogen in soil has been observed in consequence of the various experimental treatments. On the other hand, the carbon and nitrogen content of the soil continues high.

Soil Biology

Dhar, N. R. ROLE OF ORGANIC MATTER IN SOIL FERTILITY. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 314-320. 1960. (Allahabad U., Allahabad, India.)

Experimental results show that the chief function of organic substances like sugars, straw, leaves, sawdust, grass, etc. when plowed in the soil is to fix atmospheric nitrogen on the soil surface and to protect the nitrogenous compounds present in the soil or added to it just as carbohydrates preserve the body proteins. Moreover this nitrogen fixation which is the chief source of the world soil nitrogen is increased by sunlight or artificial light absorption and by addition of calcium phosphates. A mixture of straw and basic slag can fix nitrogen markedly and produce excellent crops. In these experiments, it has been discovered that the numbers of azotobacter, total bacteria and fungi are smaller in light than in the dark, but the nitrogen fixation per gram of carbon of the carbonaceous compounds oxidised is much greater in light than in the dark.

Similarly in the composting of plant materials, both light absorption and calcium phosphates markedly fix atmospheric nitrogen and the total nitrogen of the phosphated composts is double of that of ordinary composts. These experiments have been confirmed by G. Bjalfove of Uppsala and others and increased crop production has been obtained in England, Sweden and India by straw and basic slag.

For producing the total amounts of food, fibre and fodder, in the whole world approximately 200 million tons of nitrogen are needed. Only 7 million tons of nitrogen are supplied by the chemical nitrogen industry. Legumes provide 5 million tons. Rain, snow, etc. contribute about 5 million tons. Hence the soil nitrogen is still the main supplier of the world crops and organic matter which is always produced by photosynthesis aided by sunlight and calcium phosphates is making this demand of soil nitrogen replenishment.

It seems likely that the fertility of world prairie lands is caused by the fixation of atmospheric nitrogen due to the slow oxidation of the organic materials in grasses aided by sunlight absorption.

All nitrogenous compounds when applied undergo slow oxidation, forming the unstable substance ammonium nitrite, which readily breaks up into nitrogen gas and water ($NH_4NO_2 = N_2 + 2H_2O + 718$ KCal) thus the recovery of nitrogen is of the order of 25 to 50 per cent of the nitrogen applied in cultivation. Organic matter retards this nitrogen loss.

Wright, J. R., and Schnitzer, M. OXYGEN-CONTAINING FUNCTIONAL GROUPS IN THE ORGANIC MATTER OF THE Ao and Bh HORIZONS OF A PODZOL. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 120-127. 1960. (Soil Res. Inst., Res. Br., Canada, Agr., Ottawa, Ontario, Canada.)

The fulvic to humic acid ratios of the alkali-extracted organic matter of the Ao and Bh horizons of a podzol were 0.4 and 5.6 respectively. While practically all of the oxygen of the fulvic acid fractions was present in the functional groups only 50 to 70 per cent of the humic acid oxygen was similarly distributed. The fulvic acids were considerably more acidic than the humic acids due entirely to the presence of more carboxyl groups. From the findings, suggestions are made concerning the role of organic matter in podzolization.

Schnitzer, M., and Wright, J. R. STUDIES ON THE OXIDATION OF THE ORGANIC MATTER OF THE Ao and Bh HORIZONS OF A PODZOL. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 112-119. 1960. (Soil Res. Inst., Res. Br., Canada Agr., Ottawa, Ontario, Canada.)

Studies on the oxidative degradation of the organic matter of a podzol soil with alkaline potassium permanganate and nitric acid showed that the organic matter of the Ao horizon contained appreciable amounts of aliphatic and/or alicyclic in addition to aromatic structures, while the organic matter of the Bh horizon consisted predominantly of aromatic structures. There were indications that the benzene rings contained hydroxyl groups as substituents.

Jansson, S. K. ON THE ESTABLISHMENT AND USE OF TAGGED MICROBIAL TISSUE IN SOIL ORGANIC MATTER RESEARCH. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 635-642. 1960. (Royal Agr. Col. Sweden, Uppsala, Sweden.)

Principles for the establishment of a tagged microflora in the soil and its use for studying soil organic matter transformations are discussed. As an example of application an experiment on the decomposition of C^{14}-tagged glucose is presented. Four consecutive glucose additions were given to two test soils. All treatments got the same glucose addition once a week, the main point being a stepwise tagging of the additions. During 16 weeks the mineralized carbon and its tracer content were determined. On the basis of the mineralisation and tracer data the decomposition and transformation of the individual glucose additions, the priming action of the glucose, and the equilibration of the glucose carbon with soil organic carbon are considered. Estimations of an active fraction of soil organic carbon are performed.

Tagging the working soil microflora will probably be a method of great value in applied soil microbiology and biochemistry.

Olsen, R. A., Meyer, M. W., Lamke, W. E., Woltemath, A. D., and Weiss, R. E. NITRATE PRODUCTION RATE AS A SOIL TEST FOR ESTIMATING FERTILIZER NITROGEN REQUIREMENTS OF CEREAL CROPS. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 463-470. 1960. (U. Nebr., Lincoln, Nebr.)

Nitrogen testing of soils presents extraordinary problems by reason of many interactions involved. Quick tests have proved ineffective in these and other studies, necessitating a biological mineralization routine, which also has limitations. These include varied NH_4^+ accumulation in soils prior to incubation analysis, depending on environment surrounding the soils prior and subsequent to sample collection, which influences the ultimate nitrifying capacity. Secondly, seasonal variations in nitrate production rate of field soils occur. Thirdly, nitrate which has accumulated during fallow or from nitrogen fertilizer application is not reflected by the test. Fourthly, soil samples collected from existing fields of legume do not reflect fully the nitrogen potential existing after legume residues have been incorporated. Limitations notwithstanding, nitrate production rate is proving reasonably effective for diagnosing nitrogen needs of Nebraska crops. Effective calibration has been accomplished with cereal crops and routine analyses are being made on farmers' samples in the University Soil Testing Laboratory.

Davey, C. B., and Papavizas, G. C. EFFECT ON DECOMPOSING ORGANIC SOIL AMENDMENTS AND NITROGEN ON FUNGI IN SOIL AND BEAN RHIZOSPHERE. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 551-557. 1960. (CRD, ARS, USDA, Beltsville, Md.)

Organic amendments and nitrogen affected soil and rhizosphere fungi and the effect was a function of a) the time between amendment incorporation and planting, b) the kind and maturity stage of the decomposing amendment, c) the habitat in which the fungi occurred (soil or rhizosphere), and d) the individual species within a fungal genus. The effect of a decomposable organic amendment on soil and rhizosphere fungi was altered considerably by supplemental nitrogen.

Jongerius, A., and Schelling, J. MICROMORPHOLOGY OF ORGANIC MATTER FORMED UNDER THE INFLUENCE OF SOIL ORGANISMS, ESPECIALLY SOIL FAUNA. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 702-710. 1960. (Netherlands Soil Survey Inst., Wageninen, the Netherlands.)

Humus forms are genetically determined by the following factors: vegetal and faunal life in the soil profile, nature of the parent material, organic matter and environmental conditions.

Important humus forms are raw humus (Duff, Rohhumus), moder and mull. Moder is characterized by surface attack of organic matter by non- or little burrowing soil animals. Down in the profile organic matter originates from illuviation. Moder has various appearances. Mull is understood to be zoogenetically formed, mechanically unseparable admixtures of clay and organic matter; larger mineral components, if any, are firmly cemented in this clay-humus complex. This conception, however, is too restricted, as authors discuss.

Anmoor (half-bog soil) is another, mineral-rich, humus form found in soils, which are continuously or periodically saturated with water. It consists of disintegrated, strongly humificated coprogeneous parts produced by aquate animals.

Other humus forms occur in peat soils.

Bartholomew, W. V., and Kirkham, D. MATHEMATICAL DESCRIPTIONS AND INTERPRETATIONS OF CULTURE INDUCED SOIL NITROGEN CHANGES. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 471-477. 1960. (N. C. State Col., Raleigh, N. C.)

A differential equation for describing the rate of change of soil organic matter and/or soil organic nitrogen is derived and evaluated. The organic matter system is assumed to be continually undergoing decomposition and replenishment. The differential equation is integrated for the case in which the decomposition rate is directly proportional to the amount of organic matter in the soil and the rate of replenishment is a constant.

The equation can be made to quite accurately describe organic matter and/or soil nitrogen changes which have occurred in many field experiments. Estimations show that new organic matter equilibriums are closely established in most soils in less than 100 years following cultivation of new land. The equation can be used to calculate increment changes in soil nitrogen and the expected contribution of soil nitrogen to crop production.

Greenland, D. J., and Nye, P. H. DOES STRAW INDUCE NITROGEN DEFICIENCY IN TROPICAL SOILS? Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 478-485. 1960. (Waite Inst., U. Adelaide, Adelaide, South Australia.)

Nitrate- and nitrifiable-nitrogen levels have been determined at fortnightly intervals in a tropical latosol receiving two dressings of 10 tons of straw annually (1) ploughed in, (2) burnt and ploughed in, (3) as a mulch and (4) burnt and left on the soil surface. All treatments were applied with and without 100 lb. of nitrogen per annum as ammonium sulphate. Only very small differences (1—2 p.p.m.) of nitrate-nitrogen were found following the incorporation of straw, whether or not ammonium sulphate was applied. Observations on the crop confirmed that little immobilisation of nitrogen was occurring. There was also little evidence of nitrogen immobilisation under the mulch. Slow decomposition, signifcant nitrogen fixation during decomposition, decomposition by termites and bacteria involving an exceptionally low nitrogen demand, and concentration of straw so that the bulk of soil remains unaffected, are suggested as reasons for the low immobilisation. An increase of nitrifiable nitrogen was found to occur if the straw was used as a mulch, but not if it was ploughed in or burnt.

Clark, F. E., and Beard, W. E. INFLUENCE OF ORGANIC MATTER ON VOLATILE LOSS OF NITROGEN FROM SOIL. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 501-508. 1960. (SWCRD, ARS, USDA, Fort Collins, Colo.)

Nitrogen deficits were determined for a silty clay loam and washed quartz sand buffered to selected pH values and variously treated. Degree of acidity was of over-riding importance among the experimental variables employed. At a given pH value, some component in soil served to promote the reactivity of nitrite and development of a much greater nitrogen deficit than occurred in sand. This specific influence in soil was greatly reduced by pre-treatment of the soil with hydrogen peroxide. Organic amendments such as peptone or alfalfa meal added to quartz sand increased the mineral nitrogen deficit. Dextrose as an additive proved to be largely inert, providing there was no interval of pre-incubation to permit the development of microbial activity. The opinion is expressed that much of the naturally occurring volatile loss of nitrogen from soils occurs during the nitrification process, and that the term aerobic denitrification does not adequately describe the loss pathway involved.

Broadbent, F. E., Burge, W. D., and Nakashima, T. FACTORS INFLUENCING THE REACTION BETWEEN AMMONIA AND SOIL ORGANIC MATTER. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 509-516. 1960. (U. Calif., Davis, Calif.)

Ammonia salts and ammonium hydroxide when added to soils in relatively low concentrations are capable of reacting with organic matter in such a way that some of the nitrogen becomes fixed in a non-exchangeable form. The reaction will occur to a limited extent in acid soils, but proceeds much more rapidly when such soils are made alkaline. Ammonia fixation will go on either in the presence or absence of oxygen, but when the reaction proceeds for several days, it appears to be more extensive in the presence of oxygen. Pure polyphenolic compounds will not fix ammonia in the absence of oxygen, but some of them react very rapidly when oxygen is present.

The organic matter-nitrogen complex formed in ammonia fixation is quite stable, and may account at least in part for the refractory nature of a large proportion of the organic nitrogen in soils.

Legg, J. O., and Allison, F. E. ROLE OF RHIZOSPHERE MICROORGANISMS IN THE UPTAKE OF NITROGEN BY PLANTS. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 545-550. 1960. (SWCRD, ARS, USDA, Beltsville, Md.)

In greenhouse tests with N^{15}-tagged fertilizers, differences in the uptake of soil N by Sudangrass at low and high fertilizer N rates were approximately three-fold on two soils. In further tests, carried out in sand culture, plants were first grown at different N levels (untagged), and then the uptake of

N^{15} from subsequent additions of N^{15}-tagged N was determined. The results showed that the uptake of tagged N varied directly with the initial plant N level, thus corresponding with the N uptake data from soils. The observed differences in uptake of N by plants is attributed primarily to differences in the immobilization of mineral N by rhizosphere microorganisms in the utilization of energy material derived from roots of varying C/N ratios.

Schachtschabel, P. FIXIERTER AMMONIUMSTICKSTOFF IN LÖB- UND MARSCHBÖDEN. [THE FIXATION OF AMMONIA IN LOESS AND MARSH SOILS.] Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 22-27. 1960. (Hannover, Herrenhäuser, Str. 2, Hannover, Germany.)

Native fixed soil NH_4 was determined on a sand bath by extraction with HF and concentrated H_2SO_4. Before extraction organic matter was mostly decomposed with H_2O_2 after adding KCl.

Ammonia liberated by HF-H_2SO_4 from the organic matter not decomposed by H_2O_2 amounted to 3.2—4.4 mg N per 100 g soil in the marsch and loess soils studied, and to 2 mg N in the topsoil.

There was a significant correlation between the contents of fixed NH_4 and of clay in the soil, the NH_4 content of the marsch soils having a mean value of 0.78 mg and of the loess soils 1.06 mg N per 1 g clay.

By Bremner's method a mean value of only 50 % of the total fixed NH_4 was obtained, and of only 20 % by boiling in n-HNO_3 for 10 minutes. There was little or no significant correlation between the NH_4 values obtained by the different methods. The same was true for the relationship between fixed NH_4 and fixed K in the dry and wet state.

Herbert, J. EVOLUTION, HEBDOMADAIRE DE L'AZOTE MINERAL EN SOL NU ET SOUS CULTURE PENDANT DEUX ANNÉES, DANS LE NORD DE LA FRANCE. [THE WEEKLY EVOLUTION OF MINERAL NITROGEN OVER A TWO YEAR PERIOD DETERMINED IN FRESH, CULTIVATED, AND BARE SOIL.] Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 82-90. 1960. (Sta. Agronomique de l'Aisne, Laon, France.)

Mineral N was determined in fresh, cultivated and bare soil every week for two years.

Rapid and important variations in mineral N were produced throughout the year, in probable relation to variations in the soil air.

The importance of the annual mineralization is emphasized. In the absence of drainage there is a low content of mineral N associated with periods of humidity or extreme dryness.

The evolution of mineral N under wheat and beet has been followed. The presence of a crop does not sensibly modify the amount of N mineralized over a fairly long period.

It is possible to construct balance-sheets for nitrogen that show that the phenomena of reorganization have, during the winter, a role of minor conservation importance. Allowing for loss of nitrogen by drainage, it is possible to specify the nitrogen available for a crop from the nitrogen present in the autumn, and therefrom calculate the requirement of fertilizer nitrogen.

Turtschin, F. B., Bersenjewa, S. N., Koritzkaja, I. A., Shidrick, G. G., and Lobowikowa, G. A. DIE STICKSTOFFUMWANDLUNG IM BODEN NACH DEN ANGABEN DER UNTERSUCHUNGEN UNTER ANWENDUNG DES ISOTOPS N^{15}. [NITROGEN EXCHANGE IN THE SOIL ACCORDING TO RESULTS OF EXPERIMENTS USING N-15.] Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 236-245. 1960. (Nauchno-Issledovatel' skii Institut po undobreniyam i insektofungitsidam., Moscow, U.S.S.R.)

1. When $(N^{15}H_4)_2SO_4$ is applied to the soil at time of sowing, the plants utilize 60—70 % of the N^{15}, 17—20 % goes into the soil organic matter, and 11—17 % is lost from the soil. When $(N^{15}H_4)_2SO_4$ is applied to the soil 2—12 months before sowing, utilization by plants falls and losses from the soil rise correspondingly.
2. With simultaneous application of unlabelled urea and labelled N^{15} from plant material, the intensity of nitrification of organic nitrogen greatly increases.
3. With nitrification of ammonia-containing nitrogen in fallowed soil, notable quantities of oxidized organic compounds insoluble in water were found as well as nitrate.
4. Data were obtained characterizing the intensity of inclusion of N^{15} from $(N^{15}H_4)_2SO_4$ into different fractions of the soil organic matter.

Patrick, W. H., Jr. NITRATE REDUCTION RATES IN A SUBMERGED SOIL AS AFFECTED BY REDOX POTENTIAL. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 494-500. 1960. (La. State U., University Station, La.)

1. Nitrate reduction rates of a submerged soil were dependent on the redox potential of the soil. Decreases in redox potential resulted in increases in nitrate reduction.
2. Nitrate reduction rates measured in this experiment were zero order with respect to nitrate nitrogen concentration.
3. The redox potential at which nitrate nitrogen became unstable in the soil was 338 millivolts at a pH of approximately 5.1. Above this potential nitrates accumulated. Below this potential nitrates disappeared.
4. Decreasing the redox potential of Crowley silt loam from 500 millivolts to —100 millivolts increased the pH from 4.6 to 7.0
5. Oxygen consumption by the soil suspension was especially high at the lower redox potentials.

Fuller, W. H., Cameron, R. E., and Raica, N., Jr. FIXATION OF NITROGEN IN DESERT SOILS BY ALGAE. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 617-623. 1960. (Ariz. Agr. Expt. Sta., U. Ariz., Tucson, Ariz.)

Many genera of algae obtained from desert crusts were identified as belonging to the orders of Cyanophyta, Chlorophyta, Chrysophyta, Pyrophyta, Englenophyta and Diatoms. Over half of the genera identified were blue-green algae. Many of the blue-green algae were shown to be autotrophic both with respect to nitrogen as well as carbon. The ability of many of the desert algae to fix atmospheric nitrogen makes them an important group of soil microorganisms both from a standpoint of basic as well as practical science. Algal and lichen crusts were found to be four to five times as high in nitrogen as the soil below. Both algal crusts and algae in pure and mixed cultures were found to fix nitrogen. This nitrogen was shown to be available to plants.

Rich, C. I. AMMONIUM FIXATION BY TWO RED-YELLOW PODOZOLIC SOILS AS INFLUENCED BY INTERLAYER-AL IN CLAY MINERALS. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 468-475. 1960. (Va. Agr. Expt. Sta., Blacksburg, Va.)

The partial filling of the interlayer spaces of soil vermiculite with hydroxy-Al groups, a common pedogenic process in acid soils, was shown to influence NH_4 fixation by two Red-Yellow Podzolic soils. The hydroxy-Al groups reduce collapsibility of the vermiculite structure and reduce fixation in the soil horizon concerned, but may permit deeper penetration of the soil by the NH_4 and actually promote fixation by deeper horizons containing vermiculite that has a higher fixing capacity.

Fixed NH_4 inherited from the parent material, was estimated through a proposed relationship to total K. The parent material of the soils studied contained as much as 4 % K and the average NH_4/K ratio in the C horizon was one NH_4 ion to 58 K ions.

Schmidt, E. L. NITRATE FORMATION BY ASPERGILLUS FLAVUS IN PURE AND MIXED CULTURE NATURAL ENVIRONMENTS. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 600-607. 1960. (U. Minn., St. Paul, Minn.)

The heterotrophic soil microorganism, *Aspergillus flavus*, capable of nitrate formation in artificial culture media, was studied in relation to its possible significance in soil nitrification.

Pure cultures of the organism in alfalfa and barnyard manure resulted in nitrate production. The same residues incorporated into soil yielded no nitrate in pure culture systems. Sterile carbonaceous residues and the several sterile soils inoculated with *A. flavus* gave no indication of nitrate formation.

No evidence was obtained for nitrate production by the heterotroph in mixed culture environments, although plate counts indicated that the fungus was capable of colonizing soil in the presence of a mixed flora inoculum. Streptomycin sensitive components of a mixed flora soil inoculum, and not *A. flavus*, were responsible for the nitrate formation observed in mixed culture soil systems.

Shtina, E. A. ZONALITY IN THE DISTRIBUTION OF SOIL ALGAE COMMUNITIES. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 630-634. 1960. (Agr. Inst. Kirov, U.S.S.R.)

The regular change of algae communities in soil zones are concerned with the pattern of algae distribution from the ephemeral surface films to stable communities of diffusive distribution in the solum.

In the zones with a sparse vegetation cover the algae cover the free soil surface and propagate rapidly and intensely during the periods of temporary moistening and favourable temperature.

Under a dense grass vegetation in well formed dern-podzolic soils and chernozems the development of the soil proper algae is stimulated. They inhabit mostly in the soil root layer and partially use root secretions.

Under forests the algae develop mostly in the upper soil layer.

Some regular changes in the composition of algae were noted. Of all the zonal soils the dern-podzolic soils and chernozems display the greatest algae species diversity. The total number of algae species is reduced to the north and south of the soils.

Ziemiecka, J., and Kobus, J. INFLUENCE OF DIFFERENT COMPOUNDS ON THE MICROBIAL ACTIVITIES IN SANDY SOILS. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 679-684. 1960. (Dept. Agr. Microbiology, Inst. Soil Mangt. and Plant Cultivation., Pulawy, Poland.)

1. Organic manures being needed for the rise of fertility of sandy soils, their choice ought to be carefully studied in respect of their influence on the biological dynamics of these soils.

Green manuring with Leguminous plants may be applied only in small quantities, acting as a starter for the development of microorganisms and it ought to be added together with slowly decomposing and absorbing manures, f.i. with peat, so as to avoid big losses of organic matter and Nitrogen from the soil and to help the humus accumulation.

2. Also the farmyard manure added to sand without anything else does not help humus and Nitrogen accumulation and it may be perhaps applied together with peat.

3. An addition of binding substances to sand improves the fertility of sandy soils (their humus and Nitrogen content).

4. As shown by some older works of our laboratory and by the present one, the associations of cellulolytic microorganisms are composed in light and acid soils chiefly of molds. After application of different organic manures the molds are gradually replaced in these soils by myxobacteria and afterwards by the very active Cytophaga sp. This seems to be related with the gradual rise of the pH of the soil and with the accumulation of soluble Nitrogen. However every kind of organic manure does influence the composition of cellulolytic associations in a special way.

Norman, A. G. MICROBIAL PRODUCTS AFFECTING ROOT DEVELOPMENT. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 531-536. 1960. (U. Mich., Ann Arbor, Mich.)

Microbial products of an antibiotic nature have been proved to repress the growth of plant roots, or to cause such injury to root cells that solutes are released. It is presumed that if products of this type are produced by rhizosphere organisms, they may enter the plant or be adsorbed to root surfaces, in the immediate vicinity of the loci of production. Effects on the welfare of the plant as a whole would then depend on the total amount entering the plant or the total volume of the damaged tissues.

Pochon, J., Roche, A., Charpentier, M., and Tardieux, P. EFFET RHIZOSPHERIQUE DU MAIS (ZEA MAYS L.) EN CULTURE HYDROPONIQUE AUX PREMIERS STADES DE CROISSANCE. I. GROUPMENTS BACTERIENS PHYSIOLOGIQUES. [RHIZOSPHERIC EFFECT OF CORN (ZEA MAYS L.) IN A HYDROPONIC CULTURE AT THE FIRST STAGES OF GROWTH. I. BACTERIAL PHYSIOLOGICAL GROUPINGS.] Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 558-561. 1960. (Inst. Pasteur, Paris, France.)

The evaluation of early rhizospheric influence of maize on the microflora of a soil may be deduced from the results of simple laboratory experiments. Germination and first stages of growth are obtained by hydroponic culture in distilled water, in jars sterilized before the placing of the seeds and before adding a diluted suspension of a soil of reference.

In this way one collects the microbes as supplied by the soil and the seed. A quantitative and qualitative determination is made before germination and after the growth of the seedling in the presence of one or the other or both types of micro-flora. The distribution of the various physiological groups is particularly studied from a qualitative point of view.

Tardieux, P., Lajudie, J., and Chalvignac, M. A. EFFET RHIZOSPHERIQUE DU MAIS (ZEA MAYS L.) EN CULTURE HYDROPONIQUE AUX PERMIERS STADES DE CROISSANCE. II. MORPHOLOGIE DES BACTERIES ET TYPES NUTRITIONNELS. [RHIZOSPHERIC EFFECT OF CORN (ZEA MAYS L.) IN A HYDROPONIC CULTURE AT THE FIRST STAGES OF GROWTH. II. MORPHOLOGY OF BACTERIA AND NUTRITIONAL TYPES.] Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 562-567. 1960. (Inst. Pasteur, Paris, France.)

The stimulation of microbial development through the growth of a maize seedling is evinced by a preferential increase of nonsporeferous Gram-negative bacilli. They are mobile or immobile pigment producers and constitute the most important part of the microflora both of the soil and of the seed.

A study of the distribution of the various nutritional groups revealed a relative increase of species of low synthesis power. It seems that this may be attributed on the one hand to matter excreted by the rootlets and on the other to the synthesis of growth factors essential for certain types of telluric germs, by the micro-organisms of the seed.

Koltchéva, G. DÉVELOPPEMENT DE LA MICROFLORE DU SOL Ā DIFFÉRENTE PROFONDEUR DE CULTURE DE BASE DU SOL. [DEVELOPMENT OF THE MICROFLORA OF THE SOIL AT VARYING DEPTHS OF CULTIVATION OF THE SOIL.] Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 685-688. 1960. (Faculte' d' Agronomie, Sofia, Bulgaria.)

1. Subsoil cultivation to depths of 30—35 and 45—50 cm stimulates development of ammonifying bacteria and microscopic fungi. Quantities of bacilli and actinomycetes are not affected.

2. Inverting the soil causes more rapid development of nitrifiers, azotobacter and microbacteria than non-inversion.

3. Cultivation of leached chernozem-smolnitza by inverting the soil to 30—35 cm depth produces optimal development of most groups of micro-organisms.

Silver, W. S. ENZYMATIC AND NON-ENZYMATIC REACTIONS OF NITRITE IN AUTOTROPIC AND HETEROTROPHIC MICROORGANISMS. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 592-599. 1960. (Col. Agr., U. Fla., Gainesville, Fla.)

1. Nitrite appears to penetrate heterotrophic microorganisms and *Nitrobacter* most readily under acid conditions wherein the undissociated acid is present in greater amounts.

2. At an acid pH nitrite inhibited the respiration of the heterotrophs and was slowly oxidized by the nitrifier.

3. Ferrocytochrome c and nitrite react aerobically under acid conditions to form a ferricytochrome c-NO complex. The effect of pH on this reaction and on the inhibition of heterotrophic respiration by nitrite are strikingly similar.

Katznelson, H. RECENT STUDIES ON THE RHIZOSPHERE PHENOMENON. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 537-544. 1960. (Microbiology Res. Inst., Res. Br., Canada Dept. Agr., Ottawa, Ontario, Canada.)

Various aspects of the rhizosphere phenomenon were studied. *Azotobacter* counts were very low in the rhizospheres of a wide variety of crops; the greatest rhizosphere effect occurred on wheat and radish roots in a poor soil. The incidence of bacteria requiring vitamins was greater on the seed and roots of a flax variety resistant to *Fusarium oxysporum f. lini* than on the susceptible variety. The reverse was true for bacteria synthesizing these vitamins. Thiamine-producing bacteria from soil supported growth of thiamine-requiring *Phytophthora cryptogea* in thiamine-deficient media. Fungi associated with seed of flax, barley and wheat played little part in colonizing healthy roots growing in soil. Both soil inhabiting and plant parasitic nematodes were stimulated in the rhizosphere of cereals and legumes. Numbers of nematodes and bacteria (including amino acid requiring and specific physiological types) were reduced in the rhizosphere of plants grown under reduced illumination.

Soil - Plant - Animal Relationships

Bear, F. E. SOILS IN RELATION TO NUTRITIONAL VALUES IN FOODS. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 1-6. 1960. (Rutgers U., New Brunswick,.N. J.)

Nutritional values of *whole* plants of any species vary greatly depending on soil-climate complexes under which they grew. Plants often absorb excess of one mineral nutrient at the expense of others of like properties. But me. summation values of nutrient cations and anions tend to remain constant. Mineral deficiencies and imbalances are common in livestock consuming the produce of only one plant and soil. Co, I, and P are common deficiencies, and K, Mo, and Se are often in excess. These troubles are remedied by feeding mineral mixtures. Man avoids such problems by eating the produce of many plants and soils, plus animal products. Food in tropical regions is higher in carbohydrates and lower in proteins and minerals than that of irrigated arid regions, that of other regions being in between. Man often consumes excess NaCl. Substitution of salt mixtures seems logical. But S and Co must be supplied in specific organic forms.

Ahmad, M. ALUMINUM TOXICITY OF CERTAIN SOILS ON THE COAST OF BRITISH GUIANA AND PROBLEMS OF THEIR AGRICULTURAL UTILISATION. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 161-170. 1960. (Dept. Agr., Georgetown, British Guiana.)

The various types of pegasse or organic soils of the coast of British Guiana contain toxic levels of aluminium for most crop plants. The natural vegetation consists mainly of species capable of accumulating aluminium in their tissues. Plant nutrition studies show that adsorbed aluminium tends to accumulate in the roots and in the case of maize excessive amounts cause root discoloration, dead root tips and coralloid root formation. The ability to translocate aluminium to other parts of the plant tends to vary with species. Experiments indicate that cowpea is more capable of doing this than maize. This ability is regarded as an important adaptation for plants growing in these soils. Treatment of these soils with heavy dressings of ground limestone and phosphorus seem to be effective in reducing the availability of aluminium.

Kubota, J., and Lazar, V. A. COBALT-IRON RELATIONSHIP IN SANDY SOILS. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 134-141. 1960. (SCS, USDA, Ithaca, N.Y.)

Sandy and loamy sand Coastal plain soils of southeastern United States contain appreciably less cobalt than do soils of comparable texture of the glaciated northeastern United States. Within each soil region, the cobalt content is lowest in soils with Podzol morphology and highest in soils that lack profile development, such as Regosols and Alluvial soils. The Low Humic and Humic-Gleys have intermediate amounts. The low cobalt contents in the southeastern soils relate to parent material weathered prior to deposition; the higher amounts in the northeastern soils to unweathered minerals in glacial drift. Differences in levels of total cobalt among the sandy soils between the soil regions suggest basic differences in the form of soil cobalt and their availability to the plant. Low cobalt forages have been noted in both soil regions. Soil cobalt is related to iron and these factors which influence iron also affect the distribution of cobalt within the soil profile.

Jones, J. B., Jr. NUTRIENT ELEMENT REQUIREMENTS FOR SEVERAL INBRED LINES OF CORN. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 336-342. 1960. (Ohio Agr. Sta., Wooster, Ohio.)

In previous investigations, a number of corn inbred lines grown under similar environmental conditions were found to have differing nutrient element contents in their leaf tissue. The nutrient elements exhibiting the evident variation were K, Mn, B and N. The data presented in this paper is an account of a preliminary investigation to determine if the percentage nutrient element composition of the leaf tissue is a reflection of the lines requirement for that particular element. This paper concerns itself mainly with the element K.

When grown under similar environmental conditions, inbreds Pa 56 and Ohio 43 had higher leaf K contents than inbreds Pa 26, Pa 11 and Ohio 07. Growing these inbreds in solution culture, the growth of Pa 56 and Ohio 43 were accelerated by the increasing concentrations of K in the growth medium. However, Pa 29, Pa 11 and Ohio 07 did not respond as markedly to the same increasing levels of K. The cation exchange capacity of the roots of these plants were determined but the plant's responses to K could not be correlated with the cation exchange capacity of the roots.

Two four-way crosses, Ohio W 64 and K 62, were found to respond differently tochanging K concentrations in the nutrient media. Ohio K 62 developed more rapidly at lower K concentrations than Ohio W 64, but decreased in weight more sharply than Ohio W 64 at higher (excessive) levels of K.

These experiments were of short term duration and additional field studies are needed to verify their agronomic significance. In general, for the element K, level in the plant may be a reflection of the plant's requirement for this element.

Additional studies involving the elements N and Mn are in progress. One N experiment is reported. Indications are that the Mn and N level found in the plant tissue is not a reflection of the plant's requirement.

Allaway, W. H., and Beeson, K. C. FERTILIZERS AND LIME IN RELATION TO THE NUTRITIVE VALUE OF CROPS. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 12-19. 1960. (SWCRD, ARS, USDA, Ithaca, N. Y.)

In view of the fact that human diets in the United States normally include the produce of many areas, relationships between nutritional quality of human food and soil composition or soil treatments have been rare. Forage consuming livestock have shown abnormalities traceable to the minerals in the forage and to the soil where the forage was produced. Some of the most severe cases have been associated with trace element deficiencies and excesses, but it is likely that the widespread use of phosphorus bearing mineral supplements in livestock rations has masked many cases of phosphorus deficient forages. Some of the current trends in livestock production may result in the need for greater attention to the mineral relationships in soil, plants, and animals. Information on mineral inter-relationships in soil-plant-animal complex is especially deficient at this time.

Soil Classification

Simonson, R. W., and Gardiner, D. R. CONCEPT AND FUNCTIONS OF THE PEDON. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 127-131. 1960. (SCS, USDA, Washington 25, D. C.)

The term, pedon, has recently been proposed as a generic term for basic soil entities. A pedon is a small volume of soil, large enough to permit the study of horizons and their interrelationships and having a roughly circular lateral cross section of dimensions between 1 and 10 square meters. Taxonomic classes of low rank would then be considered as groups of similar pedons, whereas soil bodies delineated on maps would consist of bundles of pedons occurring together as part of the soil mantle. The pedon promises to be useful in relating soils as mapped to classes in a comprehensive system of soil classification.

Brewer, R. THE PETROGRAPHIC APPROACH TO THE STUDY OF SOILS. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 1-13. 1960. (Commonwealth Sci. and Indus. Res. Organ., Canberra, Australia.)

Petrography is, literally, the description of rocks but more especially description of their physical constitution (structure and fabric analysis) and their mineralogical constitution (mineral analysis). Petrographic principles can be applied to the study of soils provided a sound system is developed from consideration of the nature of soils and the phenomena which occur in them. Such studies are invaluable in:

(i) the characterisation of soils by description, which includes features not considered by other descriptive techniques, and by the measurement of chemical, physical and mineralogical properties,

(ii) the study of soil genesis by calculations of soil formation, the qualitative study of mineral weathering during soil formation, the interpretation of observed structure and fabric phenomena, and the interpretation of analyses of soil horizons,

(iii) the study of soil-plant relationships, especially in regard to root environment in relation to fabric, and

(iv) the classification of soil materials and soil profiles.

Beavers, A. H. USE OF X-RAY SPECTROGRAPHIC ANALYSIS FOR THE STUDY OF SOIL GENESIS. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 1-9. 1960. (U. Ill., Urbana, Ill.)

Application of X-ray spectrographic analysis has been made to soil investigations. Techniques have been developed for quantitative analysis of soils and methods for preparation of standards suited to soil investigations are described. Total analysis of soil fractions indicates mineralogical composition. Results and interpretations of X-ray spectrographic analysis of Hosmer silt loam are presented.

Pons, L. J. SOIL GENESIS AND CLASSIFICATION OF RECLAIMED PEAT SOILS IN CONNECTION WITH INITIAL SOIL FORMATION. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 205-211. 1960. (Netherlands Soil Survey Inst., Wageninen, the Netherlands.)

The peat formation and the origin of the peat has been regarded as a geogenetic process (A_{00}G-profile). Pedogenesis begins at the moment that the peat swamp is drained. The initial soil formation processes are distinguished as: physical (dehydration, stiffening, compaction and fracture of the peat mass), chemical (breakdown of carbohydrates and proteins and a comparative enrichment of mineral particles), biological (mechanical reduction and mixing of the peat material by soil fauna, ultimately developing a fairly homogeneous moulded layer (so-called organic A_1).

After these ripening processes the progressive soil formation processes, viz: the formation of an distinct organic A_1 (mull A_1 or moder A_1) and an organic B (accumulated dispersed humus) occur.

Based on the knowledge referred to the organic soils have been classified.

Heuveln, B. van., Jongerius, A., and Pons, L. J. SOIL FORMATION IN ORGANIC SOILS. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 195-204. 1960. (Netherlands Soil Survey Inst., Wageninen, the Netherlands.)

When peat is submitted to drainage pedogenetic processes occur. These processes are: physical ripening, disintegration, moulding, leaching and accumulation.

By drainage and by roots peat looses water irreversibly. This causes a reduction of the peat mass and increasing of the water storing capacity. When physical ripening continues very long, turf is formed or the peat dries out irreversibly.

Components of the organic matter are decomposed e.g. by air, bacteria, fungi and actinomycetes. After this process original remains are in any way microscopically recognizable. The disintegrated layer is indicated as C-horizon. Gradually soil animals appear, feeding on the plant remains which are reduced and excreted. Repetition of this process causes further reduction.

Moulding is distinguished according to the throphic conditions of the milieu. The mould layer is always physically ripened, shows the lowest C/N-ratio and is indicated as an organic A1-horizon (muck, Moorerde; peaty muck, vererdete Moore). When moulding leads to formation of unstable humus forms leaching of disperse humus can occur. The accumulation (organic B-horizon), is indicated for special cases by way of radiocarbon dating of peat and humus.

Ryzhov, S. N., and Zimina, N. I. PHYSICAL MATURITY OF THE MAIN SOILS IN THE IRRIGATED ZONE OF MIDDLE ASIA. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 584-589. 1960. (Acad. Agr. Uzbekistan, Tashkert, Uzbekistan, S.S.R.)

On the basis of experimental investigations the values of physical maturity in the principal Mid-Asian soils have been established.

It has been revealed that moisture characterizing physical soil maturity under which soil displays its best crushing capacity following cultivation is equal or near to Atterberg's flattening boundary.

The state of soil physical maturity in heavily cultivated plots reveals increased moisture at the expense of increased humus content and greater soil dispersion.

Ruhe, R. V. ELEMENTS OF THE SOIL LANDSCAPE. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 165-170. 1960. (SCS, USDA, Iowa State U., Ames, Iowa.)

Denudation causes a younger geomorphic surface to be cut into and below an older surface. In fully developed terrain four landscape elements are formed: upland, pediment backslope, pediment footslope, and alluvial toeslope. Transported sediment commonly accumulates on the younger erosion surface or as an alluvial fill at the toe of the surface. Upon stabilization of the younger surface a new cycle of pedogenesis follows. Soils form on elements of the landscape, and are members of a catena in the sense originally defined by Milne: '. . . the sequence of soils encountered between the crest of a low hill and the floor of the adjacent swamp, the profile changing . . . with conditions of drainage and *past history of the land surface* . . the topography was modelled by denudation or other process . . . Soil differences were brought about by drainage conditions, *differential transport of eroded material*, and leaching, translocation, and redeposition of mobile chemical constituents . . .'

Wilde, S. A. THE ROLE OF ORGANISMS IN THE GENESIS OF FOREST SOILS. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 711-714. 1960. (U. Wis., Madison, Wis.)

In environments permitting uninterrupted activity of bacteria and actinomycetes, soil development proceeds under the influence of *leucinization*, a process leading to development of *cryptorganic soils* of siallitic, ferallitic, calcareous and quartzose substrata.

Where microbiological activity is periodically arrested by freezing or drought, the surface soil layer is enriched in a black, decay-resistant residue of lignin derivatives and nitrogenous compounds. This alteration produces *melanized soils* of different substrata, such as *melanized feralites*, *melanized siallites* or *brownearths*, *rendzinas*, *melanized subarctic soils* and *alpine swards*.

Conditions restricting activity of soil organisms and permitting the development of an ectorganic mor layer, lead to the formation of *podzols*, *podzolic soils* and *grey wooded* soils.

Hydration of minerals, reduction of iron and manganese, and other changes leading to the development of *gley-cryptorganic*, *gley-melanized* and *gley-podzolic* soils are intimately connected with activity of anaerobic bacteria, algae, protozoa, nematodes, ringed worms, and crustaceans.

Låg, J. STUDIES ON QUANTITATIVE RELATIONSHIPS BETWEEN SOILS AND SOIL-FORMING FACTORS IN NORWEGIAN FORESTS. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 152-156. 1960. (Agr. Col. Norway, Vollebekk, Norway.)

The principles of the elucidation of quantitative relationships between soils and soil-forming factors have been discussed. As a name for this direction in research soligenesimetry has been suggested.

In Norwegian forests attempts have been made to study the effect of the individual factors on the proportional areas of podzol and brown earth, respectively. The change in each individual factor leading to the same displacement in the proportional area of the soil types, should thus have the same effect. In other words, we should try to find the magnitude of the changes required for the different factors to balance each other. This working method may be said to have for its principle the quantitative expression of the effect of the soil-forming factors on the basis of mutual counterbalancing of the changes in each individual factor. For the factors that cannot be characterized numerically, the use of scales of rank order is suggested.

The development of the profile seems to be more intimately bound up with the type of ground cover vegetation than with the tree species. The podzol area increases with increasing height above sea level and decreases with increasing gradient. In the preliminary investigations referred to an increase in gradient from one class to the next seems to be approximately counterbalanced by an increase in height above sea level of one class (150 m).

Pawluk, S. CHARACTERISTICS OF GRAY WOODED SOILS DEVELOPED FROM GLACIAL TILL DEPOSITS IN THE PEACE RIVER DISTRICT AND NORTH CENTRAL REGIONS OF ALBERTA. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 314-322. 1960. (Dept. Soil Sci., Edmonton, Alberta, Canada.)

Gray Wooded soils have been mapped in the northern and western extremes of the Parkland regions and Forest regions of Alberta. These soils occur in the better drained topographic positions largely under aspen poplar (*Populus tremuloides*) forest cover.

Morphologically, the soils included in this study have a thin surface layer comprised of undecomposed and semi-decomposed organic material underlain by a platy eluviated horizon. The horizon of illuviation (B) forms largely as a result of clay accumulation. The C horizon is calcareous till.

These Gray Wooded soils have a fairly high base saturation attaining a minimum in the A_2 horizon, although the minimum pH generally occurs in the lower portion of the B horizon. The major portion of exchange acidity may be attributed to aluminum ions adsorbed on the exchange complex.

Analytical data for five profiles suggest that the transposition of clay from the A_2 horizon to the B horizon is accompanied by the breakdown and transformation of illite clay in the coarse clay fraction of the A_2 horizon to montmorillonite in the fine clay fraction of the B horizon. A 14Å mineral resembling chlorite appears to occur in the coarse clay fraction of the A_2 horizon as an intermediary stage in the transformation; although, the amount of this mineral present was found to be variable among the profiles.

Hoeksema, K. J., and Edelman, C. H. THE ROLE OF BIOLOGICAL HOMOGENIZATION IN THE FORMATION AND TRANSFORMATION OF GRAY-BROWN PODZOLIC SOILS. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 402-405. 1960. (Lab. of Geology, Mineralogy and Pedology, Wageningen, the Netherlands.)

We called the intermingling of soil particles 'biological homogenization'. We consider homogenization as the counterpart of heterogenization, i.e. the formation of clearly distinguishable soil horizons.

The characteristics of any soil profile depend on the possibilities of homogenization and heterogenization in the past and in the present. Up to now more attention has been paid to the characteristics of degeneration caused by heterogenization than to the characteristics of regeneration mostly due to biological homogenization.

The zonal type of gray-brown-podzolic soil is related with the climate of the Younger-Dryas-period. The factor of soil formation 'time' has often been considered to be a multiplier. In reality this factor means that there are many soil profiles with a polygenetic soil formation.

As the term 'anthropic-B' is not quite correct, we suggest to use for the described phenomenon the term 'A_3 biol' when there is a B, or 'A_4 biol' when not.

Douglas, L. A., and Tedrow, J. C. F. TUNDRA SOILS OF ARTIC ALASKA. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 291-305. 1960. (Rutgers, The State U., New Brunswick, N. J.)

Pedologic processes of tundra soils of Northern Alaska are qualitatively similar to those found in wet soils of the northern forest zones. Acid and calcareous tundra soils exist and the pedogenic process tends to produce an acid gley profile. Salt accumulations are occasionally found on the unvegetated spots (frost boils) associated with tundra soils. Cation exchange capacity varies with organic matter distribution within profiles. There is reason to believe that some of the organic matter in tundra soils may be the remnant of a former land surface that has been buried by displacement associated with ground ice growth. Texture of Alaskan tundra soils is typically a silt loam inherited from the parent material. Water cannot penetrate the tjaele. Field evidence indicates that moisture movement in tundra soils is semi-lateral and confined to the upper portion of the active layer. Frost action and solifluction disrupt in part the morphology acquired from pedologic processes.

Simonett, D. S. SOIL GENESIS ON BASALT IN NORTH QUEENSLAND. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 238-243. 1960. (U. Kans., Lawrence, Kans.)

A series of latosolic soils have developed on the basalts of the Cairns-Atherton-Mareeba area of North Queensland in which the mineralogy of the clay fraction changes mainly in response to variations in mean annual rainfall. The percentage of kaolinite in the clays, and the silica-sesquioxide, silica-alumina, silica-iron, and silica-titanium ratios all decrease with increasing rainfall. They follow essentially the same type of function as that obtained by Tanada in Hawaii, i.e. $\log y = k - m \log x$, where y is the kaolin percentage or the appropriate molecular ratio, k and m are constants expressing the slope of the function, and x is the mean annual rainfall in inches.

Crompton, E. THE SIGNIFICANCE OF THE WEATHERING/LEACHING RATIO IN THE DIFFERENTIATION OF MAJOR SOIL GROUPS, WITH PARTICULAR REFERENCE TO SOME VERY STRONGLY LEACHED BROWN EARTHS ON THE HILLS OF BRITAIN. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 406-413. 1960. (Durham, U. Sch. Agr., Kings Col., Newcastle upon Tyne, Durham, England.)

In an interpretation of the occurrence of various secondary products in soils, based on the Polynov leaching sequence, it is suggested that weathering and leaching should be regarded as separate processes, and that the differentiation of the main soil profiles of the world can be broadly explained in terms of the weathering/leaching ratio. A high ratio tends towards a concentrated soil solution and facilitates the precipitation of a variety of secondary products whilst a low ratio results in the rapid removal of most constituents and a weathering product dominated by hydrous oxides and therefore having a low Si/R ratio. Podzolisation occurs through the influence of acid mor humus and results in a rise in the Si/R ratio, whilst gleying due to poor drainage involves a lowering of the Si/Fe and Si/Mn ratios.

It is also suggested that clay eluviation tends to be most active in neutral to slightly acid conditions, maintained by a certain balance of weathering and leaching.

Thorp, J., and Bellis, E. SOILS OF THE KENYA HIGHLANDS IN RELATION TO LAND FORMS. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 329-334. 1960. (Earlham Col., Richmond, Ind.)

The equatorial Kenya Highlands, an area of great geologic and geomorphic complexity, shows several stages of peneplanation, rift faulting, volcanism and deep dissection of the land. The variable relief, in turn, has engendered great local variation in rainfall, temperature, natural vegetation, and soils.

Vertical zonation of soils and vegetation is very marked on Mt. Kenya (Elevation 17,058 ft.) and other high mountains. Generally, soil organic matter increases and pH decreases with elevation. Friable red soils (Latosols) of many kinds occur in humid formerly forested highlands, and red soils with laterite horizons abound on plateau remnants and seepy footslopes. Brunizem, Chernozem, Chestnut and Brown soils are widespread in subhumid to semiarid grasslands and savannahs, where volcanic ash and tuff are the chief parent rocks. Black, brown and gray Grumusols are extensive on smooth slopes and level lands where rainfall varies between 20 and 45 inches. Solonetz, solodized Solonetz, and Planosols are extensive on smooth plateaus and alluvial fans, where they are associated with normal Pedocals and Grumusols.

Obeng, H. B., and Quagraine, K. A. CHARACTERISTICS OF SOME LATOSOLS AND ASSOCIATED SOILS FROM THE NORTHWESTERN SAVANNAH ZONE OF GHANA, WEST AFRICA. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 251-256. 1960. (Soil and Land Survey Br., Kumasi, Ghana.)

Data on physico-chemical characteristics of some Latosols and Associated Hydromorphics from the North-western savannah zone of Ghana are presented. The two soil groups have developed over pre-cambrian rocks mainly granites and phyllites and occur on savannah-covered peneplain land forms under sub-humid climates. Local farming is mainly on subsistance basis.

The Latosols consist of concretionary reddish brown clays and nonconcretionary yellowish red clays. They are well-drained, structureless, near-neutral to moderately acid, low in nutrients with kaolinite as the dominant clay mineral. The Associated Hydromorphics are poorly-drained and comprise of Groundwater Laterites and Savannah Gleisols. Groundwater Laterites are structureless, near-neutral to moderately acid, very low in nutrients with a clay mineral predominantly kaolinite. Savannah Gleisols, however, are prismatic in structure, acid throughout, fairly high in nutrients with illite as the dominant clay mineral.

Dudal, R., and Soepraptohardjo, M. SOME CONSIDERATIONS ON THE GENETIC RELATIONSHIP BETWEEN LATOSOLS AND ANDOSOLS IN JAVA (INDONESIA). Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 229-237. 1960. (Land and Water Development Div., FAO, Rome, Italy.)

In Java Latosols and Andosols are mainly formed from unconsolidated andesitic or basaltic materials under climatic conditions varying from humid to sub-humid tropical.

Volcanic formations covered with a material of the same composition, and subjected to soil formation for a sufficiently long time, present following soil sequence from sea level to the top of the volcano: dark red Latosols, dark reddish brown Latosols, brown Latosols and Andosols. With colours becoming less red in hue and decreasing in chroma one notices a decrease in soil depth, decrease in clay content, increase in silt content, decrease of silica sesquioxide ratio, higher hydration, increase in organic matter content and stronger development of the A1 horizon. Concurrently, rainfall increases, temperature decreases and the dry season shortens.

The composition of this sequence and the elevation at which the different members occur differ with local climate and the age of the soil formation. On relatively recent ash deposits, however, Andosols may be found at sea level. With age the lower Andosol limit moves upwards, whilst at the lower end the sequence develops progressively into the different stages of the Latosol group.

Soils similar to Andosols occur in several parts of the world under a wide range of different climatic conditions. This can be understood if one considers Andosols as an initial stage of soil formation from volcanic material under humid conditions. Where the climate is permanently humid and cool Andosols acquire a relative stability. Under other conditions their further development depends on the local climate, drainage and parent material. They were found in association with Latosols, Gray Brown Podzolic soils, Planosols, Brown Podzolic soils, Acid Brown Forest soils, Grumusols or Reddish Prairie soils.

Smith, G. D. A NEW SOIL CLASSIFICATION SCHEME PROGRESS REPORT. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 105-111. 1960. (SCS, USDA, Washington 25, D. C.)

Increased emphasis is placed on the three-dimensional nature of the soil individual. The new system attempts to define in as quantitative a manner as possible the major kinds of soil that have been recognized. This has necessitated minor regroupings in all classes. Nomenclature has been completely revised. An effort has been made to base the definitions exclusively on soil properties, and on the properties that the soils have now, rather than on the properties of the virgin soils.

Harris, S. A. A NEW GENETIC CLASSIFICATION OF THE MAJOR WORLD SOIL GROUPS. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 138-151. 1960. (Dept. Agr., Georgetown, British Guiana.)

The soils are first divided into monocyclic and polycyclic classes, based on the presence or absence of signs in the profile of more than one soil forming environment. Climate is used to give the two orders of temperate — tundra and tropical — sub tropical soils. This geographical boundary is made provisionally along the belt of hot deserts in the Horse latitudes. Each of these four groupings is split into eight sub-orders according to parent material. For this, the combinations of calcareous and non-calcareous, saline and non-saline and base rich and base deficient parent material are used.

In each of these primary divisions of the monocyclic soils, eight genetic soil types can be recognised, viz. organic gley, podzol, chernozem, arid and steppe, saline, rendzina, latosol and black cotton soil groups. Sub-division into sub-types is based on drainage and intensity of weathering. The genetic relations of these subtypes are shown on a series of diagrams with effective rainfall/evaporation and drainage as ordinates.

In polycyclic soils, the probable monocyclic subtypes are deduced. Classification consists of listing the probable sequence of subtypes passed through by the soil in order of time using formulae. Thus a murram-sierozem (7b—4a) denotes a former murram, which now has superimposed characteristics akin to a sierozem. A sub-division into normal, eroded (x), buried (y) or transported (z) species according to whether the original soil has remained intact or has been eroded or buried, or else transported and redeposited by wind is suggested, the prefix being added in chronological position.

These groupings of both monocyclic and polycyclic soils can then be subdivided as in the present mapping systems used in Russia, America or elsewhere.

Katschinski, N. A. KLASSIFIKATION DER BÖDEN NACN IHRER TEXTUR. [CLASSIFICATION OF SOILS ACCORDING TO TEXTURE.] Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 130-137. 1960. (Staatliche Lomonsow- U. and Inst. Soil Sci., Moscow, U.S.S.R.)

This paper is reviews the principles underlying the classification of soils according to their texture as widely applied in soil research in the Soviet Union and in some of the countries of Asia and Europe.

Table 1 gives our latest classification of the mechanical elements of the soil according to their precipitation velocities in water by the Stokes' formula.

Since the yield of different fractions is largely determined by the method of preparation of the sample to be analysed and partly — by the precipitation technique adopted for suspensions one cannot but admit that *any classification of soils according* to their texture should be arranged in conformity with the *mechanical analysis chosen.* In view of the above it is impossible to apply this or that classification arbitrarily, regardless of the mechanical analysis method. Our classification of soils according to the texture includes two scales: brief (table 2) and detailed.

When mapping on larger scales a more detailed classification is required. The soil obtains a more detailed denomination, according to the texture. For example: medium clay, silty, clayey or heavy loam etc.

A detailed classification for all soil survey operations on larger scales, beginning with a scale of 1 : 25,000 and further, is proposed.

TABLE 1.

Effective diameter of mechanical elements in soil (mm)		Names of mechanical elements
>3		stones
3—1		gravel
1—0,5	sand	coarse-graded
0,5—0,25		medium-graded
0,25—0,05		fine-graded
0,05—0,01	silt	coarse-graded
0,01—0,005		medium-graded
0,005—0,001		fine-graded
0,001—0,0005	clay	coarse-graded
0,0005—0,0001		fine-graded
<0,0001		colloidal
>0,01		'physical' sand
<0,01		'physical' clay

TABLE 2. *Brief scale*

Physical clay content (of particles < 0,01 mm %)			Brief soil name according to texture
Soils			
Podzolic type of soil-formation	Steppe-type soil-formation; red and yellow soils	Slightly and strongly salinized soils	
0—5	0—5	0—5	Loose sand
5—10	5—10	5—10	Close sand
10—20	10—20	10—15	Sand loam
20—30	20—30	15—20	Light loam
30—40	30—45	20—30	Medium loam
40—50	45—60	30—40	Heavy loam
50—65	60—75	40—50	Light clay
65—80	75—85	50—65	Medium clay
>85	>85	>65	Heavy clay

Classification of soils according to grade of stoneness

Ref. No.	% of particles 3 mm	Grade of stoneness	Mode of stoneness
1.	<0,5	Non-stony soil	Established according to the skeleton part
2.	0,5—5	Slightly stony	Soils may be boulder-type, graveltype, and rubble-type.
3.	5—10	Medium story	
4.	>10	Stony	

Yaalon, D. H. SOME IMPLICATIONS OF FUNDAMENTAL CONCEPTS OF PEDOLOGY IN SOIL CLASSIFICATION. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 119-123. 1960. (Dept. Geology, Hebrew U. Jerusalem, Jerusalem, Israel.)

Systems of soil classification which are based on the contemporary soil forming factors, or which stress one variable to the practical exclusion of the others, are guilty of oversimplification. They are theoretically at fault in their implication that a state of equilibrium exists at any time between the conditioning factor and the soil properties. They disregard the ever present lag in readjustment behind the changing environment.

To define and classify a genetic soil type it is necessary to assess its complete evolutionary history which includes an evaluation of past environmental conditions as well as a knowledge of the mechanism of the soil processes which have shaped it. Owing to our scant knowledge of soil dynamics, present systems have only a limited applicability.

Schelling, J. NEW ASPECTS OF SOIL CLASSIFICATION WITH PARTICULAR REFERENCE TO RECLAIMED HYDROMORPHIC SOILS. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 218-224. 1960. (Netherlands Soil Survey Inst., Wageninen, the Netherlands.)

The following aspects of soil formation are recognized: ripening, fossil and recent formation of gley, formation of A_1 and B horizons and other translocations of material in the soil.

Ripening is a process of irreversible loss of moisture in which soft mud becomes firm soil. It is important to agriculture. No differentiation between recent and fossil gley phenomena is possible with the existing definable gley criteria. Some criteria have been tested. For practical purposes a characterisation of the groundwater is important. The depth of the mean highest and mean lowest annual levels is estimated with reference to morphological characteristics. The most suitable criteria are the depth of specific grey mottles and of the G. But relationships differ between varying parent materials and under other conditions. Formation of A and B horizons is important. In many cases only smaller translocations of soil material occur. These may be valuable for differentiating between recent soils.

Vink, A. P. A. QUANTITATIVE ASPECTS OF LANDCLASSIFICATION. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 371-378. 1960. (International Training Centre for Aerial Survey--Delft, the Netherlands.)

Land classification is a general term in connection with soil science, meaning ‘all those groupings of soils that are made from the standpoint of the people that are using the soils in a practical sense’. All good land classification is based on a good soil classification. The various kinds of land classification must be well defined, particularly the difference between the various ‘interpretive soil groupings’ and the land classification for ‘recommended use’ resp. for ‘programme effectuation’.

Soil quality classification and soil suitability classification are the main interpretive soil groupings. The former has no economic bias, whereas the latter always has. The problems of soil suitability must be cleared by the soil scientist in cooperation with specialists from various other branches of agricultural science by using quantitative methods. The formula in paragraph 4 and the data from tables 3 and 4 indicate how this is done in the

Netherlands. The effective solution of these problems is felt to be of general importance for the effective use of soil classification and soil survey for practical purposes.

Desaunettes, J. R. CLASSIFICATION BINAIRE DES SOLS EN FONCTION DE LEUR VALEUR. [BINARY CLASSIFICATION OF SOILS AS A FUNCTION OF THEIR VALUE.] Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 379-387. 1960. (Compagnie Nat. Aménagement de la Région du Bas-Rhône et du Languedoc, Nîmes, France.)

The 'binary classification of soils as a function of their value' described herein is based on two fundamental factors — the useful depth of soil, and the water-holding capacity in its widest sense.

These two notions, symbolized by two pairs of figures, suffice to define completely the value and use capabilities of a soil. In particular cases the addition of a letter enables the conditions of amelioration to be specified; the place of this letter depends on the urgency of the work.

Applying these principles, a cartographic classification is proposed for irrigable soils, with five classes, namely:

1. Non-irrigable.
2. Irrigation subordinate to amelioration.
3. Irrigable soils which can be improved by irrigation.
4. Soils without major defects: 4 sub-classes: thin or deep soils, with large or small water retention.
5. Special soils where a local characteristic (e.g. active limestone) imposes particular precautions.

Sys, C. PRINCIPLES OF SOIL CLASSIFICATION IN THE BELGIAN CONGO. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 112-118. 1960. (Institut National pour l'Etude agronomique du Congo belge., Brussels, Belgium.)

The soil classification presented will be based on morphological and genetic principles: profile development, degree of weathering with respect to structure, degree of gleying, texture and color.

Since there exists various interpretation of the solum in tropical areas it seems necessary to explain our concept on the profile development. The genetic profile in tropical soils presents an A-B-C, horizon sequence, in which the B horizon is characterised by a maximum in color and in clay content, but is very thick.

The orders are established with regard to major differences in weathering and profile development. The orders are subdivided in several suborders with regard to pedo-climate. Horizon development is at the base of the establishment of soil groups. With progressive weathering the structure is degrading. Kaolisoils with good developed structure are Ferrisols, more weathered soils without good structure in which the clay-skins are vanishing are Ferralsols.

Vlasiuk, P. A., and Grintchenko, A. SOIL INVESTIGATION IN THE FARM MANAGEMENT SYSTEM OF THE UKRAINE. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 347-351. 1960. (Ukrainian Acad. Agr. Sci., Kiev, Ukrainian, S.S.R.)

The total area of the Ukrainian Soviet Socialist Republic is estimated as about 60,000,000 ha. The proportion of farmland to the total area in the Ukraine is 78 %, and in some steppe districts it rises to 88 %. The percentage of farmland in the Ukrainian SSR is one of the highest in the world.

Since 1956—'57 all-round soil survey and large scale mapping has been carried out. By 1961 all farmland of the Ukraine will have been surveyed on the area of 47,000,000 ha.

The soil survey has resulted in large-scale maps (1 : 25,000 or 1 : 10,000) and cartograms with technical information which make possible in every collective and state farm a rational utilization of the data obtained.

Every farm receives a monograph besides the maps. In the monograph the soil and its agronomic characteristics are described according to contours.

Soil survey data are used by farms for planning agrotechnical measures and first of all for elaborating a farm management system.

The system of farm management having been elaborated, it is possible to estimate the output of agricultural production from 100 ha of farmland, to evaluate the land economically as the main means of production in agriculture. In its turn the economical evaluation of the land gives a criterion for comparison of results of farms both in the case of their being located under equal economical and natural conditions and for state comparative description of farms located under various economical and natural conditions.

On this basis the Ukrainian SSR will later on be divided into agricultural regions.

Aandahl, A. R. SOIL PRODUCTIVITY--CONCEPT AND PREDICTIONS. Trans. 7th International Cong. Soil Sci., Madison, Wis. IV: 365-370. 1960. (SCS, USDA, Lincoln, Nebr.)

Production from a tract of land results from the combined effects of the soil, its climate, the things man does, and the skill with which he does them.

Management systems are the combinations of things that man does and they are defined in terms of inputs. Management levels are classes used to evaluate the results achieved in relation to a specific objective.

The productivity of a soil is the aggregate of the responses — quantity and quality of plants harvested—to *all* management systems. It is a very broad concept and a full statement of the productivity of a soil is a statement of the alternatives or opportunities which exist.

Yield predictions of crops grown on a specific soil for defined management systems are the most useful way to describe soil productivity. They are the 'building blocks' for economic analyses.

Erosion Equation

Wischmeier, W. H., and Smith, D. D. A UNIVERSAL SOIL-LOSS EQUATION TO GUIDE CONSERVATION FARM PLANNING. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 418-425. 1960. (SWCRD, ARS, USDA, Lafayette, Ind.)

The soil-loss estimating procedure presented employs recent research developments to provide more accurate guides for conservation farm planning. The equation expresses field soil loss in tons per acre as a function of rainfall characteristics, storm distribution, soil, topography, cover, crop sequence, productivity, tillage, residue management, and erosion-control practices. Measurements of existent climatic and physical conditions provide evaluations of terms in the equation which estimate the basic soil-loss rate for a field. Other terms apply information from 30 years of erosion-control research in 21 states to estimate how much this basic rate could be reduced with each of various feasible combinations of elective cropping and management practices. Combinations which will hold soil loss below an allowable limit can be considered in selecting a farm production plan that will maximize returns while safeguarding future production potential. Sources of information for localized evaluations of factors in the erosion equation are presented.

Wind and Water Erosion

Chepil, W. S. THE CYCLE OF WIND EROSION. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 225-231. 1960. (SWCRD, ARS, USDA, Manhattan, Kans.)

The cycle of wind erosion embodies the causes, effects, and remedies of wind erosion. Soil destabilization processes are the basic causes of wind erosion and the erodible conditions resulting from these basic causes may be termed the primary causes.

The effects of the basic and primary causes are soil erosion and the products that result therefrom.

The remedies of wind erosion are the soil stabilization processes and all the nonerodible soil and surface conditions that result from them.

There is a continual transition between soil stabilization processes on the one hand and soil destabilization processes on the other. But always associated with the soil destabilization processes are the processes of soil erosion and their resulting products.

Associated with the cycle of wind erosion are the processes of soil formation and soil removal.

Meyer, L. D., and Mannering, J. V. SOIL AND WATER CONSERVATION RESEARCH WITH THE RAINULATOR. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 457-463. 1960. (SWCRD, ARS, USDA, Lafayette, Ind.)

The rainulator is a research tool which produces simulated rainfall for erosion studies on rectangular plots. Numerous characteristics which are desirable for runoff plot research were included in the design of the rainulator and its associated equipment. Studies consist of a series of successive storms on various treatments. The results supplement those obtained from natural rainfall studies and are obtained more rapidly and efficiently.

Numerous studies have been conducted with the rainulator. In one study, minimum tillage for corn was found to significantly increase infiltration and reduce soil loss as compared to conventional tillage. In another, shredded cornstalks reduced erosion approximately 60 per cent as compared to stalks as left by the cornpicker. The soil and water conservation merits of various other soil, crop, and tillage treatments have also been investigated. These investigations assist in relating the various factors which influence methods of conservation farm planning.

SOIL MANAGEMENT

Cropping Practices

Ishizuka, Y. CONTRIBUTION OF THE NUTRIO-PHYSIOLOGICAL STUDIES TO THE FERTILIZER APPLICATION FOR LOWLAND RICE IN JAPAN. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 24-37. 1960. (Hokkaido U., Sapporo, Hokkaido, Japan.)

Through the efforts mentioned above the production of rice is increasing year after year cooperating with the other disciplines of agriculture. Our present knowledge and current practice for the cultivation of the rice plant is adequate to produce enough rice as the main food for our present population.

Japanese scientists plan to increase the yield of rice by about 20 %, but to decrease the acreage of rice fields about 20 %, devoting that released land for the cultivation of forage crops to keep cattle. This is needed for the improvement of our national health and also to produce an increase in the amount of protein from the land to replace the decrease of protein from the ocean.

For that purpose, we are now endeavouring to develop a new rotation system, to replace continuous rice on a given area by a rotation of rice with oats, clover and corn:

Rice—Rice—Rice—Rice—Rice— $\genfrac{}{}{0pt}{}{\text{Red Clover}}{\text{Oats}}$ —Red Clover—Corn—Rice
Low Land under irrigation Upland after complete drainage

Crop Residue Management

Larson, W. E., Burrows, W. C., and Willis, W. O. SOIL TEMPERATURE, SOIL MOISTURE AND CORN GROWTH AS INFLUENCED BY MULCHES OF CROP RESIDUES. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 629-637. 1960. (SWCRD, ARS, USDA, Ames, Iowa.)

Tillage practices that maintain mulches of plant residues on the surface of the soil usually keep the soil cooler during the early part of the growing season and frequently maintain a higher moisture content in the surface soil in North Central United States. The lowered soil temperatures are directly associated with lowered growth of corn in the early growing season. Excessive soil moisture caused by the mulch is inversely related to corn growth early in the growing season.

In experiments where the soil under a mulch was heated to about the same temperature as bare soil, corn growth was about equal. In 16 experiments over the humid region of the United States growth early in the growing season was reduced generally by a mulch in areas where the average soil temperature at a 4-inch soil depth was below 75° F. Above this temperature growth was not usually influenced.

Jamison, V. C. WATER MOVEMENT RESTRICTION BY PLANT RESIDUES IN A SILT LOAM SOIL. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 464-472. 1960. (SWCRD, ARS, USDA, Columbia, Mo.)

Soil models were used to study the transmission of moisture across barriers formed by turning under plant residues. After a heavy application of water the air-filled porosity of Mexico silt loam was very low only a short time where the surface was initially loose. If compacted to 1.3 gm/cc the time was increased. The presence of a shredded cornstalk barrier further increased the time of low air content. Hydraulic gradients in the contact zone between surface and subsoil was usually greater than in the soil body. This was increased by plant residues severing contact. Moderate compaction of the soil surface reduced flow across the barrier at low suctions. The average reduction in conductivity across the boundary by a trash barrier was much greater at high than at low suctions.

Tillage

Frese, H., Von. HABEN WIR EIN KONZEPT FÜR EINE WISSENSCHAFT VON DER BODENBEARBEITUNG? [DO WE HAVE A CONCEPT FOR A SCIENCE OF SOIL TILLAGE?] Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 54-66. 1960. (Braunschweig-Völkenrode, Deutschland, West Germany.)

Every kind of soil cultivation acts directly on the soil structure, thereby changing a complex of numerous morphological, physical, chemical and biological factors which influence plant growth. Yield measurements reflect merely something of the momentary effect of certain operations under the given environmental conditions, but nothing about the significance of single, yield-determining factors. They cannot therefore be applied to other conditions or for any kind of prediction.

To clarify the connexion between changes in soil structure and plant growth the condition of the soil must be very accurately defined, and the greatest possible number of active factors that can be reliably measured must be taken into account. The available methods, however, are not only unsatisfactory but also differ from each other so much that their results are not comparable. Thus for a concept of a science of soil cultivation there is still lacking much basic, generally utilizable knowledge which can only be obtained by more systematic collaboration of branches of special and applied research, but above all by simpler methods of procedures.

Peterson, A. E. ADVANTAGES OF WHEEL TRACK CORN PLANTING. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 590-597. 1960. (U. Wis., Madison, Wis.)

Wheel track corn planting is a simple way for growers to provide an excellent seedbed formed by the wheel tracks, and an excellent rootbed formed by the loose soil between the wheel tracks. Rapid seed germination results from this firm seedbed. Contour wheel tracks increase depression storage and the loose soil between the rows absorbs rainfall more rapidly, thus reducing soil and water losses.

Herbicides applied at planting time reduce the number of cultivations needed, and thus by going over the field three times, once for plowing, once for planting and once for cultivation the corn crop will be grown. Soil structure and organic matter that has developed during the years that the field has been in sod will not be destroyed by needless tillage, the infiltration rate of the soil will be maintained and the physical condition of the soil and its productivity will improve.

Grinchenko, A. M., and Shing, T. R. THE EFFECT OF PROLONGED CROP CULTIVATION ON DYNAMICS OF HUMUS, NITROGEN AND PHOSPHORUS IN SOILS OF THE SOUTHERN UKRAINE. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 456-462. 1960. ("Dokuchaev" Agr. Inst., Kharkov, U.S.S.R.)

1. After ploughing the virgin soil the humus content in the soil decreases with the increase of cultivation age. Soil organic matter decomposition is especially distinct in the first 5 years after the virgin land having been first brought under cultivation.
2. Periodical sowings under the grass rotation system of perennial grasses in arid steppe regions of the southern Ukraine do not produce any positive effect on accumulation of organic matter (humus).
3. In the dark-chestnut soil of Ascania-Nova under the fallow rotation system of annual grain crops the total amount of nitrogen does not decrease. The content of nitrogen in the dark-chestnut soil under the fallow rotation system even increases in comparison to the virgin soil and the soil under the grass rotation system.
4. The nitrogen supply in the ploughed layer of the soil under the fallow rotation system becomes active. The available nitrogen content in the upper ploughed layers is much greater than in the lower horizons. In the soil under the grass rotation system, the hydrolized nitrogen content decreases markedly.
5. The content of the phosphates soluble in 0.5 N CH_3COOH was greater at the beginning of ploughing, in the course of prolonged cultivation the amount of phosphates of that group decreased.
6. It follows from the data obtained that grassland farming on steppe dark-chestnut soil results in a considerable decrease in phosphorus assimilation. In view of this, application of phosphorus fertilizers to leguminous grass (alfalfa) under the grass rotation system is very important in the improvement of nutrition regime and increasing the crop-capacity.

Mukerjee, H. N. REALISTIC DETERMINATION OF NUTRIENT REQUIREMENTS OF SOILS THROUGH EXTENSIVE RANDOM SIMPLE EXPERIMENTS ON FARMERS' FIELDS. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 112-122. 1960. (FAO, Far East Reg. Off., Bangkok, Thailand.)

The present methods of conducting experiments on experiment stations and testing soils from individual farmers' fields are not adequate for giving realistic advice on the economic use of fertilizers.

A technique has been developed for obtaining more realistic information. This consists of conducting numerous simple experiments on farmers' fields, adopting the usual factorial designs, but the blocks are scattered at random on different sites, within each homogeneous soil-climatic unit. Complete information about the soil horizons, soil-test values, past cropping and manuring, rotation practiced, irrigation, cultural and other management practices, etc., are recorded and pooled analyses of the results are made in order to obtain the nutrient combinations necessary to give the required yields under situations which have the greatest number of observable crop growth factors in common. Fertilizer requirements for maximum possible yield, maximum return for dollar invested, as also the soil-test crop-response correlations are calculated.

Rennie, D. A., and Spratt, E. D. THE INFLUENCE OF FERTILIZER PLACEMENT ON 'A' VALUES. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 535-543. 1960. (U. Saskatchewan, Saskatoon, Saskatchewan, Canada.)

Theoretical considerations were reviewed which indicated that isotopic exchange, mooted as a possible and perhaps serious factor invalidating tracer-P ('A' value) experiments, may be disregarded where band (seed placement), rather than mixed placement of the tagged carrier is used. This hypothesis was confirmed experimentally from 'A' value data obtained from an experiment in which two phosphorus carriers, $NH_4H_2PO_4$ and resin-P, were mixed throughout four soils and placed with the seed (banded).

It was further shown that the reversion of the tagged fertilizer, when mixed throughout the soils, to less available forms which occurred to varying extents in the different soils, seriously invalidated the 'A' value data. Band placement effectively minimized 'fixation' reactions that occurred between the fertilizer-P and the soil constituents, thus insuring that the 'A' value data obtained only reflect differing levels of available soil-P, and not a changing fertilizer standard.

In the presence of decaying organic residues (straw) mixed placement of the fertilizer-P resulted in an increase in the 'A' value as compared to a 'no straw' treatment. This was shown to be due to immobilization of the fertilizer standard, rather than release of phosphorus from the straw. When the fertilizer-P was banded with the seed, the 'lower' 'A' value indicated immobilization of the soil-P.

It is concluded that 'A' values obtained from mixed placement of the phosphorus fertilizer may reflect isotopic exchange and fertilizer-P fixation in addition to the level of available soil-P. The limited soil: fertilizer contact afforded by band placement minimized the effects of isotopic exchange and fertilizer-P fixation, thereby resulting in a more valid measurement of soil-P availability.

Wilkinson, S. R., and Ohlrogge, A. J. FERTILIZER NUTRIENT UPTAKE AS RELATED TO ROOT DEVELOPMENT IN THE FERTILIZER BAND: INFLUENCE OF NITROGEN AND PHOSPHORUS FERTILIZER ON ENDOGENOUS AUXIN CONTENT OF SOYBEAN ROOTS. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 234-242. 1960. (Purdue U., Agr. Expt. Sta., Lafayette, Ind.)

Soybean secondary roots responded to localized placements of nitrogen and phosphorus with increased lateral root development as was previously found with corn. Nitrogen fertilizer-enhanced endogenous auxin content was thought to be involved in this increased root branching. Soybeans were grown at varying nitrogen and/or phosphorus levels in expanded vermiculite, and sand and the root systems extracted for auxin to evaluate this hypothesis.

Indoleacetic acid was not found in any of the root extracts. Growth activity was associated with tryptophan. Extracts from roots grown at high nitrogen levels produced more growth activity than extracts of roots grown at low nitrogen levels. The increased activity associated with higher nitrogen levels did not appear to be simply increased production of tryptophan, but rather increased production of another growth active substance having a slightly higher Rf value in isopropyl alcohol: water solvent. Growth activity in the Avena straight growth test, soybean root tip test, and Ehrlich positive spots on chromatographed extracts support this conclusion. The unknown substance gave a yellow color reaction with p-dimethylaminobenzaldehyde.

Homès, M. V. THE USE OF A TEST-PLANT FOR DETERMINING THE FERTILIZER REQUIREMENT OF ANOTHER PLANT. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 161-167. 1960. (U. Brussels, Brussels, Belgium.)

Various methods are based on the use of a test plant for determining the amount of nutrients of a soil. They are frequently criticized. Those objections failed when the test plant is used to determine the total fertility of the soil and not the particular value of one element, and, chiefly when the method is based not only on the analysis of the exportation of the test plant.

The method of 'Systematic Variations' gives easily and surely the 'absolute requirements' of a plant in an inert substrate and the requirements of the same plant in a given substrate ('complementary requirements'). An experiment of 'Systematic Variations' on a test plant (e.g. Maize) leads easily to the determination of 'the local fertility' of a soil (complete composition). The combination of the local fertility of a soil and the absolute requirement of a plant, intended to be cultivated on this soil, gives the composition of the best fertilizer for the culture of this plant on the considered soil.

An application of the method leads to practical fertilizers for Cocoa tree, Coffea tree, and Palm tree.

Bruce, R. C., and Tyner, E. H. TIMING NITROGEN APPLICATIONS FOR MAIZE IN TROPICAL REGIONS CHARACTERIZED BY WET AND DRY SEASONS. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 504-509. 1960. (Col. Agr., U. Philippines, Laguna, Philippines.)

Efficient response of maize to N applications in tropical areas characterized by pronounced wet and dry seasons is highly dependent upon the time when the N is applied.

Under climatic conditions similar to those which prevail at the University of the Philippines Central Experiment Station, maximum response to N fertilization of the dry-season crop occurred only when all the N was applied in the row at planting time.

The greatest response for the wet-season crop occurred when the total N application was proportionately applied as follows: one-fourth in the row at planting time, one-half topdressed 4 weeks after planting and one-fourth topdressed 7 weeks after planting.

Galvez, N. L. SOME FACTORS AFFECTING FERTILIZATION OF PADDY SOILS. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 268-275. 1960. (Col. Agr., U. Philippines, Dilman, Quezon City, Philippines.)

Weeds should be removed before applying fertilizers. Soil type, depth of mud and rice variety tend to influence the efficacy of nitrogen fertilizers in paddy soils. Split application of 30 to 60 Kg. nitrogen, one-third at time of planting and two-thirds, twenty days before booting is suggested for paddy rice. The one-third nitrogen application at planting may be omitted during the wet season.

Dry season fertilization with relatively higher number of sunshine-hours gives higher and more consistent increases in yields than the wet season with lower number of sunshinehours.

Wider distance of planting increases the efficiency of fertilization whereas narrower spacing tends to decrease it.

Rice varieties, which would stand heavy fertilization, should be used in paddy soil fertilization.

Viets, F. G., Jr. RECOVERY OF FERTILIZER NITROGEN ON IRRIGATED AND DRYLAND SOILS OF THE WESTERN UNITED STATES. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 486-493. 1960. (SWCRD, ARS, USDA, Fort Collins, Colo.)

Results of four field experiments on the recovery of fertilizer nitrogen showed very poor recovery in three experiments situated on fine-textured soils. Recovery ranged from about 7 to 50 per cent of the nitrogen applied. On a fine sandy loam the nitrogen recovery was about 80 per cent. In these experiments, nitrogen was applied once at various rates to grass or for several years to a sequence of crops using several carriers at a range of rates all within the range of agronomic feasibility. All nitrogen removed in crops was measured and cropping was continued without fertilization until all residual nitrogen was removed. Erosional and leaching losses were eliminated by choice of site and irrigation procedure. Losses of nitrogen by ammonia volatilization and instability of nitrite do not appear to be adequate to explain the losses observed. Denitrification following rain or irrigation may account for some of the losses.

Wittich, W. DUNGUNG HUMUSVERARMTER WALDBÖDEN. [FERTILIZING HUMUS-DEFICIENT FOREST SOILS.] Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 384-392. 1960. (Institut für Bodenkunde, Göttingen, Germany.)

The poor performance of humus-impoverished forest soils is a consequence less of the absolute low content of humus as of the one-sided impoverishment in compounds important for nitrogen mobilization. The residual humus is relatively enriched in ash-rich humic acids and other resistant substances. In humid climates these lose a large part of their nitrogen, mainly α-amino-N. Disappearance of 30 % of the soil humus indicates a retrogression of N supply, which come mainly from humus, to a fraction of normal. Numerous other changes in the soil condition are connected with this. But the week point, which must be taken into consideration in all measures of reclamation, is the nitrogen supply. By cultivation of nitrogen collectors, for which good growth conditions can be created by mineral fertilizers, even extreme growth disturbances can be corrected in a short time. New humus is built up, and the nitrogen-starved humus residue is enriched. Fertilizing and silvicultural-biological measures must be coordinated and must often be continued in another form after disappearance of the legumes. The aim of fertilizing in the forest should be to create the best possible soil condition which ensures the optimal nutrition of the trees for a long time.

Tamm, C. O. NUTRIENT UPTAKE AND GROWTH AFTER FOREST FERTILIZATION IN SWEDEN. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 347-354. 1960. (Forest Res. Inst. Sweden., Stockholm 51, Sweden.)

Fertilization experiments in Sweden are reported to show a positive effect of nitrogen in forests on mineral sites. Stands growing on drained peatland often respond to application of phosphorus and potassium. Further work has been devoted to show the extent to which the nutrient applications are used by the stand. Nutrient concentrations in the needles increase after fertilization, but measurements of the total nutrient content of stands show that only a small portion of the element additions is used by the trees. A large amount of the applications of phosphorus and calcium can be relocated in the top soil four years after treatment. This does not apply to nitrogen and potassium. Some implications of importance for the practical use of commercial fertilizers in forestry are discussed.

Maki, T. E. SOME EFFECTS OF FERTILIZERS ON LOBLOLLY PINE. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 363-375. 1960. (N. C. State Col., Raleigh, N. C.)

Ammonium nitrate and superphosphate at two levels and muriate of potash at one level were applied to different-aged loblolly pine plantations in March of three consecutive years, beginning in 1951, on the Hill Forest in Durham County, North Carolina.

The treatments supplying nitrogen increased needle length, raised the nutrient concentrations in the foliage, increased the amount of annual litter deposition, and improved the vigor of the pines as reflected in better diameter growth and greater basal areas. Initial indications of possible height growth superiority, while still visible after nine years, are beginning to fade. In one plantation established on an abandoned old field, mortality and suppression have amounted to almost thirty per cent of the original number of free-growing stems in the stand at establishment, suggesting that fertilizers might possibly be used as a 'tool' for thinning over-dense stands.

White, D. P. EFFECT OF FERTILIZATION AND WEED CONTROL ON THE ESTABLISHMENT, SURVIVAL AND EARLY GROWTH OF SPRUCE PLANTATIONS. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 355-361. 1960. (Mich. State U., East Lansing, Mich.)

The effects of commercial type fertilizer (14-7-7) containing ureaformaldehyde nitrogen, pressed fertilizer pellets, site preparation and weed control with simazine were analyzed on the survival, growth and foliage color of spruce plantations in Michigan.

Observations based on 2-3 years growth following treatment on a variety of sandy planting sites were tested by analysis of variance.

Techniques which helped to control weed competition were judged to be significantly beneficial to survival and growth. Furrow planting on sandy soils was superior to clean cultivation of planting strips. Simazine applied in a 20 inch band over row after planting at the rate of four pounds of actual material per acre gave excellent weed control extending into the second growing season.

No general recommendations for fertilization at the time of planting can be made from this study. Fertilization with ordinary commercial fertilizer in the planting hole or with pelleted materials containing muriate of potash was highly injurious on some test areas. Significant effects of soil amendments at the time of planting were obtained in a few instances which suggests need for further study of fertilizer formulations and proper placement.

Fertilization of spruce plantations showing nutrient deficiencies several years after establishment is recommended. Significant response in growth and foliage color can be obtained in one to two years after treatment.

Heiberg, S. O., and Leaf, A. L. POTASSIUM FERTILIZATION OF CONIFEROUS PLANTATIONS IN NEW YORK. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 376-383. 1960. (State U. Col. Forestry, Syracuse, N. Y.)

It has been demonstrated that on a level, coarse sandy, glacial outwash soil that had been exploited by agriculture for a long period, potassium additions in the form of logging debris, humus and mineral fertilizers in all cases has had a strong positive influence upon the growth and vigor of several coniferous tree species. The response from the organic matter additions, due to their content of potassium, was greater for the more nutrient demanding species. Logging slash from a productive site has a stronger effect than slash from a depleted site, and the more nutrient demanding a species the greater the effect of its slash.

Response to applications of potassium fertilizers in various forms have been immediate, strong and lasting while the response from other nutrient element additions, including nitrogen, have been slight to nil. Rates of application equivalent to 150 lb/A (165 Kg/ha) elemental potassium have resulted in a striking reaction and indicate that still higher rates of potassium applications would be effective.

Potassium deficiency symptoms have been described for several coniferous species and related to soil and foliar potassium analyses.

The effect of both organic additions and mineral potash salts lasts at least 25 years.

Jordan, H. V., Pearson, R. W., and Bardsley, C. E. SULFUR AS A PLANT NUTRIENT IN SOILS OF THE SOUTHEASTERN UNITED STATES. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 563-572. 1960. (SWCRD, ARS, USDA, State College, Miss.)

A study of sulfur as a plant nutrient in the southeastern United States established the following:

1. Sulfur is low in surface horizons of the Red-Yellow Podzolic soils of the area. There are accumulations of sulfates in lower horizons which may contribute to the needs of some crops.
2. In the southern tier of States sulfur in rainfall and atmosphere makes only a minor contribution to crop needs.
3. Sulfur added as an incidental component of fertilizers has undoubtedly maintained productivity of many South-eastern soils. With the increasing use of sulfur-free fertilizers, dependence can no longer be placed on this casual solution. Sulfur supplements band-placed with otherwise sulfur-free fertilizers increased yields in 15 of 24 field experiments in a 7-year period.
4. A single broadcast application of gypsum at a reasonable rate did not prove a completely satisfactory source of sulfur for crops, beyond the first years after application.
5. Interactions of *nitrogen* × *sulfur* and *phosphorus* × *sulfur* demonstrate the interdependence of sulfur nutrition and the general fertility level.

Ponnamperuma, F. N. THE BENEFITS OF LIMING ACID LATERITIC RICE SOILS OF CEYLON. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 285-292. 1960. (Dept. Agr., Ceylon, Colombo, Ceylon.)

Liming of acid lateritic lowland rice soils in Ceylon has given striking increases in yield. One application of slaked lime at 6 tons per acre gave an increase of over 700 lb. rough rice per acre per season for four seasons in succession on an imperfectly drained acid lateritic clay loam. In farmers' fields average responses as high as 920 lb. rough rice per acre were obtained on similar soils. Nitrogen and phosphorus fertilizers appeared to be superfluous in the season of liming. The responses to forms of lime at a lime equivalent of 6 tons per acre $Ca(OH)_2$, during the season of liming, were in the following descending order of magnitude: slaked lime, ground coral limestone, and ground dolomite. The optimum level of lime was about 6 tons ground limestone per acre on the strongly acid lowland rice soils of the low country wet zone of Ceylon.

Love, J. R., Corey, R. B., and Olsen, C. C. EFFECT OF PARTICLE SIZE AND RATE OF APPLICATION OF DOLOMITIC LIMESTONE ON SOIL pH AND GROWTH OF ALFALFA. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 293-301. 1960. (U. Wis., Madison, Wis.)

A field experiment designed to determine the relative efficiencies of various size-fractions of dolomitic limestone in raising the pH of the soil and increasing the yield of alfalfa led to the following conclusions:

1. Relative efficiencies based on soil pH are influenced by time of equilibration of the lime fractions with the soil. Finely ground limestone (< 100 mesh) reacts rapidly with the soil compared to the coarser fractions, but with increasing equilibration time the coarser fractions approach the effectiveness of the < 100 fraction.
2. Relative efficiencies based on soil pH are influenced by the magnitude of the pH change used for comparing the fractions. (The pH change is a

function of the initial pH and the reference pH used for comparison.) The coarser fractions show higher efficiencies relative to the <100 fraction the lower the reference pH.

3. The relative efficiencies determined in this field study agree well with those determined in greenhouse experiments.

4. The effects of the various fractions on the yield of alfalfa were determined primarily by their effects on the soil pH. Correlation of soil pH with alfalfa yield gave a highly significant correlation coefficient of 0.78 ($n = 72$).

Kick, H. DIE VER WENDUNG VON SIEDLUNGSABFÄLLEN ZUR VERBESSERUNG VON BÖDEN UND ZUR ERHÖHUNG DER ERTRÄGE. [USE OF COMMUNITY WASTES FOR IMPROVING THE SOILS AND FOR INCREASING THE YIELDS.] Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 321-328. 1960. (Agrikultuchemischen Institut der Universitat Bonn, Bonn, Germany.)

1. The composition of composts of garbage or garbage sewage sludge mixtures, as obtained from town refuse, differs seasonally. The contents in nitrogen, total organic matter, and 'effective' (readily hydrolyzable) organic matter are higher during the summer months than in winter times.

2. The nutritional effect of 50 tons of fermented compost is equivalent to about 25 kg N, 65 kg P_2O_5, 125 kg K_2O and 2—2,5 tons $CaCO_3$, given as commercial fertilizers. Only some 10—12 % of the total N, 8—10 % of total P, and 13—16 % of total K are plant available in the year of application. The after effect of the compost nutrients is rather small.

3. The availability of minor elements of the composts like Cu, Pb, Zn, Ge, Mn and also of B, is low, amounting to only a few hundred grams per hectare, if compost additions of 50 t/ha are made. Pb is taken up in very little amounts. Therefore, any detrimental effects to plants, animals or man are not to be expected.

4. Such composts of town refuse materials are particularly well suited for a fast and effective improvement of acid agricultural and forest soils with low humus and nutrient contents. Also the composts can be effectively used in orchards and vineyards. In horticulture, particularly with sensitive plants, the alcalinity and salt content of the composts must be carefully taken into account, and the amounts added should be adapted to the local conditions.

5. The addition of mineral plant nutrients to the compost materials prior to fermentation, as to increase their nutrient content, is not economical since the added nitrogen is almost completely lost, and phosphate is rendered unavailable. Potassium is present in the garbage and garbage sewage sludge composts in ample amounts, and lime as well.

Duchaufour, P. RECHERCHES SUR L'ACTION DE DIVERS TRAITEMENTS CHIMIQUES DES HUMUS BRUTS SUR LA NUTRITION ET LA CROISSANCE DES RESINEUX. [RESEARCHES ON THE ACTION OF DIFFERENT CHEMICAL TREATMENTS OF RAW HUMUS ON THE NUTRITION AND GROWTH OF CONIFERS.] Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 406-410. 1960. (Ecole, Nationale des Eaux et Forêts, Nancy, France.)

The essential conclusions to be drawn from this experiment are:

1. Mechanical treatment accompanied by exposure to the sun of a humus formed in the shade leads to strong biological activation — acceleration of

mineralization, narrowing of C/N ratio, rise of pH and increase of exchangeable calcium.

2. The effect on raw humus of treatment with gaseous ammonia would appear to be unfavourable to its evolution; a part of the organic matter is solubilized, and suffers loss by leaching. Besides, the neutralization is temporary, the humus becomes acid again and similar to the control, after the second year.

The solubilization of organic matter, obtained at the beginning, produces a mobilization of phosphorus.

As regards germination, this treatment produces a solid mass of seedlings.

3. The treatment with fertilizers is established as the most favourable, pH 5 being optimal; at this pH best growth is obtained.

Spruce utilizes phosphate fertilizers better than pine.

Enrichment in ammoniacal nitrogen, useful in the first year, has only an ephemeral effect, nitrogen nutrition being less marked than in the controls without fertilizers.

4. Neutralization with lime (without fertilizer) is more harmful than useful.

Excessive absorption of calcium produced by liming seems to have been detrimental to the absorption of magnesium: at pH 7,1 a marked deficiency of the latter is shown by a yellowing of the leaves and a reduction of growth. This is evidence of a calcium-magnesium 'antagonism' caused by neutralizing the humus with lime.

Salinity and Alkali Problems

Bower, C. A. SODIUM ELECTRODE AND ITS USE FOR SALINITY INVESTIGATIONS. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 16-21. 1960. (SWCRD, ARS, USDA, Riverside, Calif.)

A glass electrode which responds selectively to Na^+ in nonacid solutions is now available. The Na concentration of water, soil-water extracts and Mg acetate extracts of soils can be measured potentiometrically by the glass electrode using a calomel half-cell as the reference electrode. Methods are given for determining soluble and exchangeable Na, and cation exchange capacity by Na-saturation. Sodium determinations by the electrode and flame photometer methods were in good agreement.

Chang, C. W. A NEW METHOD FOR MEASURING MOISTURE RETENTION VALUES AND STABILITY OF STRUCTURE OF SODIUM-AFFECTED SOILS. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 217-224. 1960. (N. Mex. State U., University Park, N. Mex.)

Water-stable aggregation in irrigated soils in New Mexico cannot be determined with sufficient accuracy to demonstrate relationship with crop yield or physical and chemical properties related to exchangeable sodium. Serious difficulties have also been encountered in determining moisture retention of these soils by standard methods because of inconsistent results caused by entrapped moisture. To circumvent this difficulty, three new procedures have been developed: a direct manometric procedure, an indirect ethanol solution 'moisture equivalent' procedure, and a soil-sand mixture procedure. They serve (1) to reveal the intrinsic moisture retention property, (2) to explain hysteresis in the measurement of moisture tension-moisture content, (3) to estimate changes in soil structure by providing a numerical expression of structure stability, (4) to determine the extent to which the structure may be improved, and (5) to relate moisture retention and soil structure in a more logical manner.

Delver, P., and Kadry, L. T. ESTIMATION OF SATURATION-EXTRACT CONDUCTIVITIES FROM SATURATION-PASTE CONDUCTIVITIES AND TEXTURES FOR SALINE SOILS IN THE MESOPOTAMIAN PLAIN. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 370-377. 1960. (Ministry Agr., Baghdad, Iraq.)

In order to enable large scale soilsalinity testing with a limited laboratory capacity, the relation between saturation-paste and saturation-extract conductivities (EC_s and EC_e) was studied for a number of soilsamples originating from four different areas in the Mesopotamian plain in Iraq. The ratio $f = EC_e/EC_s$ proved to be hyperbolically related to the moisture-content at saturationpoint (SP) and the salinitylevel expressed as EC_s (fig. 2). A method in described for estimating EC_e from simple electrical conductivity measurements in soilpastes (EC_s) and SP-values. SP can be estimated by interpolation using the average relation that exists between SP and soiltexture. The weighing of soil and the measuring of the amount of water, required for making a paste, can thus be omitted. The capacity for testing based on EC_s-measurements is at least twice as high compared to testing based on EC_e-measurements. The degree of correspondence between measured and estimated EC_e is high ($r = 0{,}996$, fig. 3).

Antipow-Karatajew, I. N. PHYSIKALISCH-CHENISCHE UNTERSUCHUNGEN IM ZUSAMMENHUNG MIT DET MELIORATION DER ALKALIBÖDEN. [PHYSICAL-CHEMICAL INVESTIGATIONS INTO THE RELATIONSHIP OF ALKALI SOILS.] Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 571-576. 1960. (Inst. Für Bodenkunke, and Inst. Soil Sci., Moscow, U.S.S.R.)

Gypsum is used on a large scale in the Soviet Union for improving solonetz soils. But there is so much land with solonetz-like soils that 500—1000 million tons of gypsum would be necessary for their complete amelioration. New chemicals, like calcium chloride which is a by-product of the soda industry, are being tried. This requires the development of theoretical investigations into the problems of the evolution of different kinds of solonetz soils and a thorough characterization of their properties. As a result of soil genetic investigations special attention has been given to the possibilities of utilizing the 'inner reserves' of solonetz soils and their 'self-amelioration' — among them the presence of gypsum or calcium carbonate at available depths of the solonetz soils; and the presence of considerable quantities of colloids with favourable agronomic properties. All this has enabled us to work out, during the last 25 years, the system of 'self-amelioration' of solonetz soils that can be regarded as an agrobiological method. This system has been successfully tested under different experimental and commercial conditions, especially under irrigation.

Gibaly, H. E. GYPSUM FINENESS IN RELATION TO RECLAMATION OF ALKALI SOIL. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 528-534. 1960. (Col. Agr., U. Alexandria, Alexandria, Egypt.)

The effect of particle sizes on rapidity of reclamation of alkali soil is investigated. Finer gypsum particles are more efficient in reclaiming alkali soil than coarse particles. Gypsum has to be ground finely enough that 100 % of the material should pass 100 mesh U.S. standard sieve. A logarithmic relationship between concentration of replaced sodium in the leachate and the volume of leachate is found. The logarithmic equation is helpful in predicting the degree of improvement of reclamation of alkali soil with a certain type of gypsum. No significant differences exist between particles of gypsum finer than 100 mesh size in correcting alkali characteristics of soil.

A chemical method for calibrating the efficiency of gypsum samples of different fineness and quality is proposed. The amount of calcium chelated from 0.2 gm. gypsum by 100 ml. 0.025 N. disodium ethylene-diaminetetraacetate at 45° C after 10 minutes time reaction is a measure of the efficiency of any gypsum sample in correcting alkalinity in soil.

Darab, K., and Szabolcs, I. TYPES OF SECONDARY SOLINIZATION OF SOILS IN THE IRRIGATED ZONES OF THE REGION OF THE GREAT HUNGARIAN PLAIN. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 535-542. 1960. (Res. Inst. for Water Resources, Budapest, Hungary.)

1. The area of irrigated territories increases in Hungary to a great extent in the last years. For the time being, 70—75 % of the irrigated areas are located in the region beyond river Tisza. The majority of the irrigated soils in this region belong to meadow type soils. When drainage is not carried out with a satisfactory care or irrigation is not adequately applied, soil waters of alkaline nature may rise and the possibility of a secondary salinization must be considered.

With a view to the aforementioned, investigations were undertaken in different parts of the region beyond river Tisza with the aim to establish the effect of irrigation on the conditions of salinization of the soils of meadow type in this region.

In the course of our investigations, three distinct forms of secondary salinization were classified:

a) Accumulation of neutral alkali salts in the topsoil layers, i.e. a secondary salinization of soil.

b) Accumulation of neutral salts of alkali and alkali earth metals in the deeper horizons of the soil.

c) Increase of the content of exchangeable sodium ions of the soil, i.e. a secondary solonization.

2. The observed three types of secondary salinization not only differ in the conditions of their formation but require also various methods of proper reclamation.

In regions where neutral salts of alkali and alkali earth metals accumulate in deeper soil horizons, it is satisfactory to prevent further accumulation of salts and the appearance of a secondary salinization by a careful drainage, adequate agrotechnique and proper crop rotation.

On reclaiming secondarily solonized soils, it is necessary to lower the level of soil water, together with the simultaneous application of chemical reclaiming agents (as substances containing $CaCO_3$ or $CaSO_4$). In the case of soils subjected to secondary salinization, favourable effects can be expected by lowering the level of soil water, removing soluble salts and simultaneous application of adequate chemical reclaiming agents.

Branson, R. L., and Fireman, M. RECLAMATION OF AN IMPOSSIBLE ALKALI SOIL. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 543-552. 1960. (U. Calif., Riverside, Calif.)

A four-year field experiment was conducted to determine if it were possible to reclaim a so-called 'unreclaimable' saline-alkali soil representing as extreme a reclamation problem as exists in the world. The experiment consisted of nine different treatments replicated eight times. Reclamation was evaluated by means of infiltration measurements, soil analysis, and crop response.

The most effective treatment by all methods of evaluation, was calcium chloride. Following calcium chloride in effectiveness were the acidifying amendments: sulfuric acid, sulfur and ferric sulfate.

Gypsum increased yields to the same extent as the acidifying amendments but only after a much longer period of leaching. Treatments which supplied little or no soluble calcium did not reclaim this soil.

The study shows that this soil does not differ basically from alkali soils in other geographical areas and that it can be reclaimed by applying known principles.

Flannery, R. D. FIELD RECLAMATION TESTING PROCEDURES AND RESULTS IN THE MIDDLE EAST. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 553-559. 1960. (Tippetts-Abbett-McCarthy-Stratton, Engin., Adana, Turkey.)

1. The field reclamation tests simulating field reclamation practice provide opportunities to determine closely how much leaching is required to remove harmful chemicals from the soil. Such results would not have been possible using ordinary field and laboratory tests.
2. The tests demonstrated that soil amendments were not needed for reclamation where certain amounts of soluble calcium and magnesium salts existed.
3. The excessive accumulations of salts in the upper meter of soils in the areas represented by the three test sites can be reduced to a safe level for normal plant growth with about one (1) meter of leaching water.
4. The amount of leaching water required to remove the excessive alkalinity is a variable quantity and dependent upon the availability of the soluble salts of calcium and magnesium. It was less than one meter at the Areas A and C tests and almost three meters at the Area B test.
5. In order to apply reclamation standards in helping to determine the reclamation potential of a given area, it is considered necessary to have complete, current field and laboratory data for all the physical and chemical factors which affect the reclaimability of the soil.

Lunt, O. R., Oertli, J. J., and Kohl, H. C., Jr. INFLUENCE OF ENVIRONMENTAL CONDITIONS ON THE SALINITY TOLERANCE OF SEVERAL PLANT SPECIES. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 560-570. 1960. (U. Calif., Los Angeles, Calif.)

The response of several plants to salinity was observed when either multiple or single components of the environment varied. As independent variables affecting plant vegetative response, salinity, root temperature and air temperature exerted relatively large effects on plant growth while relative humidity exerted a small effect. With more than one depressive factor acting simultaneously, the resultant yield conformed to Baules percentage yield concept.

Legerwerff, J. V., and Ogata, G. PLANT GROWTH AS A FUNCTION OF INTERACTING ACTIVITIES OF WATER AND IONS UNDER SALINE CONDITIONS. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 475-480. 1960. (SWCRD, ARS, USDA, Riverside, Calif.)

Red kidney beans were grown on culture solutions of which the osmotic pressure (OP) was due to a base nutrient plus either an excess of ions, or purified, inert, 'Carbowax' polyethylene glycol (molecular weight 15,000—20,000). Different osmotic and ionic composition effects have been induced by varying the sodium-adsorption-ratio (SAR) at each of a number of levels of OP. The total weight was found to be functions of both the OP and SAR, underlining the relativity of salt tolerance. The yield of 'Carbowax'-treated plants was significantly greater than that of plants grown on isotonic solutions containing ions only. Extrapolation of data suggests that ionic composition effects started suppressing plant growth independently from osmotic effects at an OP of about 1.7 atm.

Doneen, L. D., and Henderson, D. W. QUALITY OF IRRIGATION WATER AND CHEMICAL AND PHYSICAL PROPERTIES OF SOIL. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 516-522. 1960. (U. Calif., Davis, Calif.)

Most irrigation waters are classified by the amount of total salts present and the sodium percentage or the sodium-absorption-ratio (6). This may be good criteria when the water consists mostly of chloride salts and they are not allowed to accumulate in the soil. But under irrigation practice the soil solution is frequently many times more concentrated than the irrigation water. The bicarbonates of the water should not be included as a part of the total salts producing salines. This precipitation may be beneficial in reducing the total salines of the irrigation water when the calcium and magnesium content is high, but if the bicarbonates and sodium are high precipitation will increase the exchangeable sodium, cause soil dispersal and aggravate the problems of leaching and tillage of the soil.

The concentration of electrolytes in the irrigation water influences the permeability of the soil. At any given exchangeable sodium percentage permeability increases rapidly with concentration, especially in the lower ranges of concentrations and at low levels of exchangeable sodium. Water with a high concentration of electrolytes, and with the sodium increasing above 70 per cent, increases the exchangeable sodium and rapidly decreases the permeability of the soil.

Pratt, P. F., Branson, R. L., and Chapman, H. D. EFFECT OF CROP, FERTILIZER, AND LEACHING ON CARBONATE PRECIPITATION AND SODIUM ACCUMULATION IN SOIL IRRIGATED WITH WATER CONTAINING BICARBONATE. Trans. 7th International Cong. Soil Sci., Madison, Wis. II: 185-192. 1960. (U. Calif., Citrus Expt. Sta., Riverside, Calif.)

The data herein presented show that the amount of leaching, the removal of Ca in harvested crops, the Ca added from fertilizers and soil amendments, and perhaps the type of crop are factors that influence $CaCO_3$ precipitation in soils irrigated with water of a given HCO_3^- content. The data suggest that the differences resulting from different crops might be largely a result of differences in water removal which influence leaching losses. This, however, is not the only effect of the crop. Differences in Ca immobilization by plant parts not harvested would have an effect, as would differences in amounts of CO_2 produced by root respiration and by decomposition of plant residues.

The data from the lysimeters suggest that under conditions of no leaching and no Ca removal by crops, essentially all the Ca added would have been precipitated as $CaCO_3$, except for the Ca used in bringing the pH of the soil from the original slightly acid value to the point where precipitation of $CaCO_3$ was initiated. Thus the maximum possible Na per cent would have been approached if there had been no leaching and no removal of Ca, Mg, or Na by removal of crops. It follows then that the greater the differential removal by crops of Ca and Mg in comparison with Na, and the greater the per cent leaching, the larger the difference between the per cent Na attained in the soil and the maximum possible per cent Na.

The Na in the water used in these experiments was 31 % of the total cations. The maximum possible Na content, assuming that all the HCO_3^- were to precipitate with Ca and Mg, would be 88 %. In the field trial where water was the only material added, or where urea was added, about half of the HCO_3^- reacted to precipitate Ca. With half of the HCO^-_3 reacting, and assuming that one equivalent of HCO_3^- precipitates one equivalent of Ca, the Na content would be 46.5 %. The average soluble Na in the saturation extract of the soil of the 0 to 48-inch depth for the check plots, where water was the only material added, and for the plots that received water plus urea, was 48 and 43 % respectively. This agreement suggests that the reaction is as assumed.

Climatic Influences

Scarseth, G. D. TEMPERATURE INFLUENCES UPON VEGETATION AND SOIL PROPERTIES. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 7-11. 1960. (Amer. Farm Res. Assoc., West Lafayette, Ind.)

This reports from field observations of nearly forty years about soils and vegetation found in the jungles of the torrid, humid tropics to the frigid, dry tundras of the arctics.

The implications of van 't Hoff's law upon biological processes in plants by extremes in temperature are discussed. In the extremes of both climates are found factors of biologic interest magnified sufficiently to lend themselves to scientific and practical interpretations.

The Lebedeff effect (Odessa) related to soil and air temperatures and the moisture available to plants under various environmental conditions are discussed.

The hypothesis is ventured that the mineral composition of plants is often masked by the limitations in the nitrogen supply. If this be true, then it's futile to attempt to relate the mineral composition of plants to soil composition, except in the instances where it is established that the mineral in question is the first limiting nutrient factor for the plant.

Mulching

Waggoner, P. E. MULCHES AND THE ENERGY BALANCE AT THE SOIL SURFACE. Trans. 7th International Cong. Soil Sci., Madison, Wis. I: 164-168. 1960. (Conn. Agr. Expt. Sta., New Haven, Conn.)

Compared to bare soil, an opaque mulch is warmed more by insolation and conducts and emits more energy upward. At night these mulches, at most points separated from the soil, receive less heat from below and lose less energy upward. These processes are exaggerated if the covering has great reflectivity or thickness or low emissivity. Consequently, the diurnal amplitude of soil temperature is decreased and the mean may be changed.

A transparent mulch transmits insolation to the soil. The loss of energy is retarded by air beneath and by the high emissivity of water on the film. The sheltering film moderates the nighttime loss, but the loss from the hot soil remains large. Thus, the temperature amplitude and mean are both increased.

Because an evaporator, a leaf, held above a sunlit surface receives energy from below as well as above, its evaporation is increased by reflective mulches.

PLANT MANAGEMENT

Woodlands

Leyton, L. THE GROWTH AND MINERAL NUTRITION OF TREE SPECIES IN RELATION TO SITE FACTORS. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 419-427. 1960. (Dept. Forestry, Oxford U., Oxford, England.)

In Britain, the restriction of plantations largely to marginal sites has been reflected in widespread nutrient deficiencies limiting tree growth. On peaty moorland sites, phosphatic fertilizers have proved particularly beneficial. In order to assess the value of foliar analysis as a means of studying growth-nutrient relationships, investigations have been made on young Japanese larch planted in various parts of the country on a variety of soil types and showing variable responses to fertilizer amendments. A significant proportion of the variation in annual height growth over these sites can be accounted for by multiple regression analyses based on the NPK status of the needles. However, only by including interaction terms can relationships be established common to all sites, indicating the limited value of diagnoses based on individual nutrients. Much of the variation in growth not accounted for in terms of the NPK-status can apparently be related to differences in exposure (temperature) between sites.

Zinke, P. J. FOREST SITE QUALITY AS RELATED TO SOIL NITROGEN CONTENT. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 411-418. 1960. (Sch. Forestry, U. Calif., Riverside, Calif.)

The study reported in this paper relates forest site quality to total soil nitrogen content. Twenty three mature site trees of *Pinus ponderosa* at locations of widely varying site quality were used in the study. The site index of each tree adjusted to age 300 years was determined, and the total soil nitrogen content determined for soil in which the tree was rooted. The site indices ranged from 20 meters to 64 meters (65'—210') and the total soil profile nitrogen contents ranged from 220 grams to 1390 grams per square meter to a depth of 122 cm. (1,960—12,350 lbs. per acre to 48" depth). Site index (height in feet at 300 years) was found to be related to soil nitrogen content Q_N (gms/m²/122 cm) by the regression equation:

$$SI = 159 (\text{Log } Q_N) - 296$$

The correlation coefficient is 0.71, and the standard error of estimate is 29 feet.

SUPPLEMENT

Radioactive Fallout

Barbier, G., Duval, L., and Tendille, C. CONTRIBUTION DE LA CHIMIE DU SOL Á L' HYGIÈNE ATOMIQUE: ÉCHANGES DE TRACES DE Sr ET Cs DANS LE SOL. [CONTRIBUTION TO THE CHEMISTRY OF SOIL AND ATOMIC HYGIENE: EXCHANGE OF TRACES OF Sr AND Ca WITHIN THE SOIL.] Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 510-516. 1960. (Etoile de Choisy, Versailles, France.)

1. It is confirmed that from the standpoint of atomic hygiene the forecasting of the long-term consequences of the progressive accumulation of Sr^{90} in the soil is simplified, relatively, by the fact that the exchange of Sr in neutral calcareous soils reaches a constant equilibrium with little variation from one exchanger to another. Besides, since Sr is retained, if anything, rather less than Ca, lysimeter data on the intensity of leaching of Ca in different pedoclimates can inform us about the leaching of Sr^{90} (reduction or accumulation; contamination of the water table).

On the contrary, the selectivity of the soil for Cs, although very strong in many cases, diminishes rapidly when the proportion of natural soil Cs increases, even if it is still in trace amount.

2. From the standpoint of the laws of cation exchange, the old empirical formulas, according to which the selectivity of the soil for any cation would increase indefinitely as the proportion of the cation tends to zero, are not in disagreement with the observed facts, but only for one of two determined cations, not for the other one (except in the case of a divalent cation in low proportion exchanging with a dominant monovalent cation).

Reitemeier, R. F., and Menzel, R. G. RELATION OF RADIOACTIVE CONTAMINATION OF CROPS TO SOIL FERTILITY. Trans. 7th International Cong. Soil Sci., Madison, Wis. III: 35-45. 1960. (Jr. Author, SWCRD, ARS, USDA, Beltsville, Md.)

Nuclear fission installations and devices are possible sources of radioisotopes which may contaminate crops and soils. With respect to the longer-term food chain hazard, most attention has been directed to the fission products strontium 89, strontium 90, and cesium 137. The uptake of radiostrontium by plants generally varies opposite to the level of exchangeable calcium in the soil. Increasing the exchangeable calcium content of highly acid soils by adding lime often reduces substantially the radiostrontium content of plants or the ratio of radiostrontium to calcium. Applications of ammonium salts have increased the uptake of radiostrontium by oats, and the uptake of radiocesium by oats and rice. Additions of potassium, however, frequently decrease the uptake of radiocesium and radiostrontium. Large additions of decomposable organic matter have reduced the uptake of radiostrontium but also that of calcium. Application of potassium, calcium amendments, or organic matter at practical rates usually will not be of sufficient benefit to serve alone as an effective control measure. The maximum production of crops therefore should be the primary basis for the fertilization of contaminated soils.